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CHARLES CARROLL BROWN, *Secretary*
P. O. Box 234
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NEXT CONVENTION

AT

HOTEL ANSLEY
ATLANTA, GA.

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REPORT OF COMMITTEE ON FIRE PREVENTION

Alcide Chaussé, Chairman, Montreal, Quebec

The fire loss in Canada during 1921 amounted to more than $45,000,000 and exceeded that of any previous year in the history of the country. Returns for the present year indicate that the conditions are going from bad to worse. Altho no conflagration of note has occurred, the widespread burning of property continues on an unprecedented scale. During the first four months of 1922, losses have amounted to $19,206,000, or almost $5,000,000 per month. The unpleasant fact must be faced that in all probability fires will continue to increase until there is a marked recovery from general business depression. The decline in the values of many basic commodities is practically completed, but there still lies ahead the inevitable collapse of urban real estate values and a substantial reduction in the costs of production, transportation and distribution. Such deflation, whether gradual or sudden, will affect the values of all insurable property and will undoubtedly be reflected in the fire-loss record.

The Ontario Fire Marshal Department has issued a booklet setting forth the Ontario lightning-rod act together with the rules and regulations for materials and their installation, authorized by the Act, and illustrations showing typical installations. The department advises protection of country homes and barns, isolated buildings, and all buildings having elevated features. Prospective purchasers are urged to have the planning done by men experienced in lightning-rod installation since almost every building presents a problem peculiar to itself. Work should be entrusted to an expert who has made a study of the subject.

At the twenty-sixth annual meeting of the National Fire Protection Association held at Atlantic City, N. J., May 9 and 10, the following resolution was unanimously adopted:

> That in its warfare against the needless sacrifice of human life and property, this Association advocates the following measures:
>
> 1. The adoption by municipalities of a Standard Building Code to the end that fire-resisting building construction may be encouraged, the use of inflammable roof coverings prohibited, adequate exit facilities from

buildings assured, and interiors so designed and fire-stopped as to prevent or materially retard the development and spread of fire therein.

2. The adoption by all states and provinces of minimum building requirements for the protection of public and private hospitals, schools, asylums and similar institutions.

3. The enactment by state and province of a fire marshal law to the end that official investigation may be made of the causes of all fires, preventable fires may be eliminated by public education, and the crime of arson stamped out thru vigorous prosecution of incendiaries.

4. The systematic inspection of all buildings by local firemen to insure the vigorous enforcement of rules for cleanliness, good housekeeping, and the maintenance of safe and unobstructed exits, fire-fighting apparatus and other protective devices, and to enable firemen to become thoroly familiar with the essential structural and other features of buildings which it is their duty to protect.

5. The enactment of laws or ordinances fixing the cost of extinguishing preventable fires upon citizens disregarding fire prevention orders, and a more general legal recognition of the common-law principle of personal liability for damage resulting from fires due to carelessness or neglect.

6. The wider general use of the automatic sprinkler as a fire extinguisher agent and life saver and the more general use of standard smoke-proof towers and of horizontal exits thru properly protected openings in fire division walls as important life-saving facilities.

7. A careful study of the technical surveys of cities made by Fire Underwriters covering the items of water supplies, their adequacy and reliability, fire department efficiency, fire alarm systems and conflagration hazards, and of the possibility of cooperation among neighboring cities thru mutual aid and the standardization of hose couplings. The organization of local fire-prevention committees to promote these objects.

8. The universal adoption and use of the safety match and legislation prohibiting smoking in all parts of factories, industrial and mercantile buidings except in such fireproof rooms as may be specially approved for the purpose by the authorities having jurisdiction.

9. The education of children and the public generally in careful habits regarding the use of fire, and the general adoption in the schools of a fire prevention manual.

10. The adoption of effective legislation regulating motion-picture displays and exchanges; the prohibition, without a standard enclosing booth, of the use of motion-picture projection machines in any building unless the film used is of the slow-burning type, and the ultimate substitution in the manufacture and use of motion-picture films of the slow-burning type in place of the nitro-cellulose film.

11. The general prohibition of the discharge or firing of fireworks, fire balloons, or other pyrotechnic displays except as a public function conducted by properly authorized individuals under the supervision of the officers of the fire departments.

12. The co-ordination of all activities thru a central administrative officer or body having primary jurisdiction, for the purpose of promoting uniformity of action and efficient cooperation.

The construction of chimneys is very important and woodwork should never be built into a chimney wall nor be permitted to touch a chimney; a separation of approximately two inches should be strictly required. This applies to all floor construction, partitions, rafters, roof boards, and shingles. Where a chimney passes thru a floor, the space between the floor timbers and the chimney should be filled with some loose incombustible material, such as cinders, refuse plaster or mortar, held in place by a sheet of metal nailed to the underside of the wooden beams. The space should not be filled with solid mortar or brickwork, since this will transmit heat. Gypsum blocks, sawed to fit the space, constitute one of the best materials for this purpose At the roof line, sheet metal protection set into the joints of the brickwork and overlapping the roof boards should be used. There are two reasons for filling the space between the chimney and the woodwork:

1. It prevents a fire originating on a lower floor, passing up behind a partition or furring surrounding the chimney into upper stories or the attic.

2. It avoids the possibility of rats or mice building nests in these spaces thus filling them with highly combustible material, which in time may be ignited from heat transmitted thru the chimney wall. Woodwork is frequently ignited in this way.

Clean up your town.

A town looks like its citizens.

Is there anything wrong with your town?

Are the back lots filled with unsightly trash?

Are the basements of public buildings full of rubbish?

Is there rubbish obstructing exits that people may have to use in an emergency?

If any of these conditions exist, there is something the matter with your town.

If your tongue were coated, your back arched and you had chills, you would go to a doctor. You would go because you were sick.

Your town is sick. Its gets clogged up like your system, and is coming to the only doctor it can come to. It is coming to you.

People judge a town by its looks.

If there have been fires in your town in the past you have had to bear the loss.

Property that could have been taxed and thus help to reduce your burden, is beyond the power of taxation.

Food that could have been eaten is destroyed.

Insurance money with all its alchemy is no substitute; it has purchasing power, not food value.

Clean up your town.

It will mean dollars and cents to you.

It may mean the saving of lives.

Your own home may be destroyed by the careless act of a neighbor.

His home is in the same danger as yours.

Sunlight, fresh air and cleanliness never cause spontaneous combustion; lack of ventilation and accumulations of filth and dirt will.

Remove every unsightly and dangerous pile of rubbish. It is your town. You live in it. And it will only be what you make it.

REPORT OF SUB-COMMITTEE ON STREET PAVING

W. A. Howell, Chairman, Newark, New Jersey

The year 1922 gave promise of being a banner year in street and highway improvements, up to May 1. During the early part of the year there were probably at least five million men out of employment and many municipal, county and state improvements were hurriedly inaugurated to help ease the unemployment situation. In the city of the writer, on March 1, 1922, there were 40,000 men unemployed. With a building program unparalleled in the history of the country, the number of people unemployed was constantly reduced. By June 1, 1922, in the city of the writer, there was sufficient work for every man willing to work. With a building program involving contracts amounting to $26,000,000, common labor soon became so scarce as to seriously affect street and highway improvements. Contractors who accepted work in March and April at the prevailing wage in force at that time found that by June and July men were not available at the old rate of pay.

Then the railroad and coal strikes took place, and the granite paving industry was completely tied up, and granite curbing, which has become more and more in vogue during recent years, became very difficult to procure on account of the shortage of cars. At the granite quarries, while men were working on monumental work and getting out curbing, the block makers were all striking and in most quarries did not go back to work until September 1, 1922. In some of the municipal quarries in eastern Massachusetts the strike is still in existence. Numerous streets in New York, Brooklyn, and neighboring towns have been torn up for months awaiting granite block shipments and many of these streets will have to be paved temporarily with old blocks until the arrival of shipments from the quarries.

There is a regrettable lack of coöperation between the granite block producers and the labor employed in the quarries. It is true that a large proportion of the men are ignorant foreigners, many of them unnaturalized, and seemingly incapable of understanding why war-time wages should not prevail indefinitely.

As a prominent member of our local city government has aptly stated, "When a man cannot afford a suit of clothes he gets along without it for the present year." So it is with pavements. If a city cannot afford to pave or repave a street with granite at the prevailing prices the improvement, altho probably badly needed, is postponed for another year.

There is another angle to this question. If paving materials known heretofore as heavy-traffic paving materials, such as granite block and wood block, persistently retain their war time prices, cities and counties will be forced to use other materials, such as asphalt and concrete, which it is conceded are not as durable as granite and wood block. But when two asphalt pavements can be laid for the cost of one granite pavement, if a city can with guaranties get ten years wear out of an asphalt pavement, it certainly would pay to entirely discard the old asphalt pavement at the end of ten years, particularly if the original concrete base remained in good condition, and resurface the old pavement. Municipalities are governed very largely by the initial cost of improvements. That the tremendous increase in building construction thruout the country was responsible for a large increase in paving mileage is very apparent. As has been previously stated, $26,000,000 will have been spent in the city of the writer during 1922 for building construction, nearly all going for apartments, single dwellings, and two family houses in residential districts. Very little of this amount is for factory construction. This means the opening up and improvement of large areas of formerly unimproved land, much of which had been assessed as acreage instead of as city lots. This statement holds good for numerous cities and towns thruout the country.

During the first eight months of this year, the total building construction started in northern New Jersey and New York, amounting to $637,534,000, was only $8,000,000 less than the amount started in the entire year of 1921. Compared with the first eight months of last year this year's increase is 77 percent. The August figures brought the total for the year to date in the entire country up to $2,362,872,000, which is not only the largest figure for the first eight months of any year, but is greater by $7,000,000 than the total for the entire year of 1921. The outstanding feature of the August statistical statement is the increase in industrial plant construction, which amounted to

$67,373,000 or 21 percent of the month's total. This is the largest monthly figure for this class of building since March, 1920. One project accounted for $35,000,000 of this large total, the by-product coke plant of the Carnegie Steel Company near Pittsburg. Even omitting this large single project, the remaining amount is greater than any monthly total since November, 1920. Residential building still maintains the lead in August with $100,882,000 worth of contracts, or 31 percent of the total. Public works and utilities amounted to $49,825,000 or 15 percent; business buildings $38,122,000 or 12 percent; and educational buildings $32,055,000 or 10 percent.

This Society does not attain to its ultimate goal of usefulness when it caters to the aims, ambitions, and enterprises of the large city. The large city has the opportunity of blazing the way for new ventures in unexplored fields by reason of having available the finances necessary to carry out new schemes. But there are countless small towns of 20,000 to 25,000 people, having a very intelligent population, who are just as alive to the advantages of good pavements and as anxious as the large cities to adopt the most approved methods of economically laying them. It behooves the representatives of the large cities, therefore, before advocating or carrying out expensive paving programs, calling for costly types of pavement, to consider carefully if any possible substitutes would answer. Granite-block pavement by reason of the ill advised action of the quarrymen and block makers, has become almost prohibitive as to cost in many cities. Wherever it is possible to do so, old granite-block pavements, laid either on sand, or on concrete bases, should be converted into napped-reclipped granite-block pavements, grouted either with cement or with asphalt and sand and relaid on either new or repaired concrete bases. Partly worn-out macadam and telford pavements, requiring a very expensive maintenance of either tarvia or road oil with or without screenings, should be resurfaced with asphalt or asphaltic concrete, doing away with the dust and the heavy cost of road oil. Worn-out brick pavements can also be placed in an excellent state of repair by receiving a coating of asphalt, and better still, thin coatings of both asphalt and binder. Partly worn-out warrenite, bitulithic or other forms of bituminous concrete pavements can have their wearing surfaces made practically new and good for several years additional wear by treating them with a surface wash costing possibly 25 cents per square yard.

A careful survey of apparently discouraging paving conditions in many cities would result in plans for resurfacing or repaving various types of pavements by utilizing as much of the original pavement as possible. Working along these lines, thousands of dollars could annually be saved to the municipality, and expensive assessments to the individual property owner.

Reports from various cities have been received as follows, which we have given below as part of this report.

REPORTS OF PAVING IN VARIOUS CITIES

Birmingham, Alabama. A. Johnston Hawkins, City Engineer.

1922 paving program calls for approximately 225,000 sq. yd. of street paving at an estimated cost of $535,000.00

Charleston, South Carolina. J. H. Dingle, City Engineer.

We are at present paving with sheet asphalt 130,000 sq. yd. A second schedule of improvements covering 300,000 sq. yd. has been adopted by the City Council. Total expenditure for the two schedules approximately $1,600,000 including drains and sewers.

Denver, Colorado. Albion M. Vickery, City Engineer.

	ESTIMATED YARDAGE	ESTIMATED COST
	sq. yd.	
Concrete alley paving	$15,700	$481,923.30
Asphaltic concrete paving on old macadam base	72,550	164,861.83
Asphaltic concrete paving on concrete base	62,420	166,868.00
		$813,643.98

Kansas City, Missouri. Robert W. Waddell, City Engineer.

During the fiscal year April 17, 1921, to April 17, 1922, the records are as follows:

	SQUARE YARDS	COST
Macadam	77,860.66	$140,496.50
Brick	50,377.46	270,270.48
Concrete	75,499.65	250,163.68
Asphalt	65,659.56	294,937.64
Stone block	9,084.26	53,418.44

We have experienced no delay in street improvements due to the railroad and coal strikes.

Cincinnati, Ohio. F. S. Krug, City Engineer.

Owing to the present financial condition of the city no improvements will be inaugurated and completed during 1922.

City and County of San Francisco. M. M. O'Shaughnessy, City Engineer.

	AMOUNT OF OF PAVEMENT CONSTRUCTED	COST
	sq. yd.	
Asphaltic concrete	131,788	$344,012.16
Concrete pavement	19,822	59,542.80
Vitified brick	1,011	5,401.12

There is a large amount of paving constructed annually by the Street Repair Department for which this office makes the surveys and prepares full working plans.

Los Angeles, Cal. John A. Griffin, City Engineer; J. L. Moyer, Engr. Cost and Estimate Department.

Report showing amount and cost of street paving constructed and accepted by the City of Los Angeles during the period from Jan. 1, 1922, to June 30, 1922.

CLASS OF PAVEMENT	MILES	AREA	TOTAL COST
		sq. yd.	
Asphalt	1.23	22,180	$65,255.62
Concrete	13.22	199,748	511,462.11
Protected concrete	0.08	1,968	5,192.11
Macadam	0.014	403	897.51
Graded and oiled	5.08	88,246	113,415.31
Totals	19.62	312.545	$696.222.66

Portland, Oregon. O. Laurgaard, City Engineer.

		COST
Number of miles of concrete paving under contract	10.66	$495,000
Number of miles of asphaltic concrete paving and asphaltic concrete redress....	2.60	67,000
Number of miles of macadam....	0.56	18,500
Totals....	13.82	$580,500

New York City, Boro of Manhattan. R. A. MacGregor, Assistant Engineer of Highways.

Contracts awarded to August 2, 1922.

	SQUARE YARDS	TOTAL CONTRACT COST
Granite....	70,300	$627,300.00
Asphalt....	125,300	521,800.00
Asphalt block....	2,400	12,400.00
	198,000	$1,161,500.00

The cost given is the estimated cost at contract prices for all the work, including curb, grading, 6″ concrete foundations, basins and pavement.

New York City, Boro of Brooklyn.

Statement showing price range of pavements on which bids were received during 1922 and yardage contract for during 1922.

PAVEMENT	DATE	PAVEMENT COST PER SQUARE YARD	PRICE RANGE CONCRETE BASE CUBIC YARD	EXCAVATION CUBIC YARD	YARDAGE
Asphalt on 6-in. Concrete					
	Jan. 18	$1.43	$7.00	$0.80	212,205
	July 26	1.25	6.50	1.25	inc. above
5-in. Granite on 6-in. Concrete					
New blocks	Mar. 15	6.75	7.75	1.35	28,942
	July 26	5.25	7.00	1.25	inc. above
Recut	July 26	2.10	6.85		4,380

PAVEMENT	DATE	PAVEMENT COST PER SQUAREYARD	PRICE RANGE CONCRETE BASE CUBIC YARD	EXCAVATION CUBIC YARD	YARDAGE
Bituminous Macadam					
	May 31 July 5	1.55 1.05	6-inch resurfacing only		198,582 inc. above
7-inch Concrete					
	June 16	2.07		0.99	34,490

Albany, N. Y. City Engineer.

TYPE	YARDAGE	AVERAGE COST PER SQUARE YARD INCLUDING CONCRETE BASE
Dressed granite	25,750	6.37
Redressed granite	41,850	3.08
Concreted (1–2½–3½)	4,665	12.40 per cu. yd.
Asphalt	9,160	2.76
Willite	4,210	2.71
Vitrified brick	2,420	
	88,055	

Pittsburg, Pa. Charles M. Reppert, Chief Engineer, Tom M. Reed, Assistant.

The City of Pittsburg, Department of Public Works, Bureau of Engineering, has contracted for the following types of pavement, some of which pavement is completed, some under way and some not yet started, for 1922.

New standard sheet asphalt pavement on 8″ concrete base, 1–2½–5 mix. 27,000 sq. yd. Average price of $3.60 per sq. yd. This price does not include excavation.

Asphalt repaving on 8″ concrete base, 1–2½–5 mix. 5400 sq. yd. Average price of $3.79 per sq. yd. This price includes the necessary sub-grading.

New vitrified brick pavement on 6″ concrete base. Some of this is 1–3–6 mix and some 1–2½–5 mix. 32,000 sq. yd. Average price of $3.67 per sq. yd. This price does not include excavation.

New blockstone pavement on 6″ and 8″ concrete base, 1–3–6 mix. 34,000 sq. yd. Average price of $4.75 per sq. yd. This price does not include excavation.

Asphaltic concrete pavement on 8″ concrete base, 1–2½–5 mix. 23,000 sq. yd. Average price of $2.86 per sq. yd. This price does not include excavation.

Asphaltic concrete repaving on 9″ concrete base. 1–3–6 mix. 13,000 sq. yd. Average price $3.21 per sq. yd. This price includes the sub-grading.

Pittsburg will undoubtedly do more paving during the remainder of the present year, but as all our work is work authorized by ordinance of the Council, we cannot foretell how much will be done.

Rochester, N. Y. C. Arthur Poole, City Engineer.

Yardage and cost of street paving work for the season 1922.

PAVEMENT	SQUARE YARDS	TOTAL COST
Asphalt	332,700	$1,014,740.00
Warrenite-bitulithic	57,800	196,520.00
Asphalt block	12,150	55,890.00
Brick	4,310	19,395.00
Wood block	3,850	15,400.00
Concrete	990	2,970.00

Cleveland, O.

Paving program, 1922.

	AREA	LENGTH	CONTRACT PRICE
	sq. yd.	*ft.*	
Brick on concrete, asphalt filler	64,350	22,089	$339,797.00
Brick on concrete, cement filler	128,452	44,005	653,007.00
Brick on sand	17,189	6,908	66,315.00
Stone on concrete, asphalt filler	3,667	1,065	31,622.00
Stone on concrete, cement filler	13,852	4,058	152,202.00
Stone on concrete, old stone	2,922	1,874	29,874.00
Reinforced concrete	5,340	1,880	22,508.00
Bituminous concrete, on concrete	38,813	11,361	167,382.00
Sheet asphalt resurfacing	81,410	26,942	276,718.00
Total	355,955	120,182	$1,739,425.00

Total yardage of street paving awarded in 1921 and completed in 1922.

	AREA	LENGTH	CONTRACT PRICE
	sq. yd.	*ft.*	
Brick on concrete	55,861	19,183	$305,166.00
Bituminous concrete on concrete	25,963	5,852	134,016.00
Total	81,824	25,035	$439,182.00

Minneapolis, Minn.
(Paved by the municipality, not by contract.)

	SQUARE YARDS	ESTIMATED COST
Asphalt concrete	167,439	$595,831.00
Creosoted blocks	73,826	563,620.00
Brick	37,421	185,260.00
Granite blocks	22,565	118,245.00
Concrete	5,567	20,898.00
	306,817	$1,283,854.00

St. Paul, Minn. Oscar Claussen, City Engineer.

Paving program for 1922 comprises all told about 350,000 sq. yd. of paving consisting of creosote blocks, reinforced concrete, brick and asphalt pavements costing in the neighborhood of $1,200,000.

Newark, N. J. Wm. A. Howell, Engineer in Charge, Bureau of Paving.

	SQUARE YARDS	COST
Asphalt on 6-inch concrete base	68,298	$261,251.84
Asphalt concrete on 6-inch concrete base	45,203	141,484.56
Asphalt resurfacing on old concrete repaired	51,800	214,814.00
Asphalt resurfacing on old telford, scarified	29,340	62,253.66
Granite on concrete	17,950	154,341.70
Grading, curbing, and flagging		48,001.20
Total	212,591	$882,146.96

Other ordinances under way will increase the above amount to at least one million dollars.

Elizabeth, N. J. Thomas E. Collins, City Engineer.

NUMBER OF STREETS	APPROXIMATE YARDAGE	ESTIMATED COST
	sq. yd.	
12	74,880	$358,000.00

Salt Lake City, Utah. Sylvester W. Cannon, City Engineer.

Our paving program for the present year includes approximately 20,000 sq. yd. of bituminous concrete pavement at a cost of about $50,000.

Baltimore, Md. R. Keith Compton, Chairman.

The following is a statement of the status of our paving for 1922:

TYPE OF PAVING	CONTRACTED FOR	COMPLETED	AVERAGE PRICE
Sh. asph. pav. 1½″ wear. surf. 1½″ binder, 6″ conc. base	250,195	58,585.59	$2.57
Vit. block 6″ base, gutters, alley returns, etc.,	5,720	1,115.30	3.49
New g.b. 6″ base, cement or asphalt filler	11,300	7,459.47	5.74
Red. g.b. 6″ base, cement or asphalt filler	7,210	3,037.20	3.10
Cement concrete, 6″ and 7″ thick	79,870	34,483.99	1.65 1.75
	354,295	104,681.55	
State Roads Commission, Sheet asph. 1½″ wear. surf, 1½″ binder, 6″ conc. base	66,400		
	420,695		

We have not given you repaving or repairs, as that would have to come from the Highways Engineer.

The above involves a program of approximately $1,250,000.00. The strike situation has not affected us very seriously as yet. The first of the year labor could be gotten in abundance and at a reasonable rate, but recently labor is scarce, and there is a slight rise in the rate per hour. The situation is such, however, that we may be seriously affected at any time, both by strikes and labor.

Wichita, Kan. P. L. Brockway, City Engineer.

We are now constructing four standard types of pavement; 6″ concrete, some of it reinforced; asphaltic concrete, having a 2″ wearing surface and a 5″ concrete base; sheet asphalt, having a 1½″ wearing surface, a 1″ binder course and a 5″ concrete base; and brick pavement, consisting of 3″ vertical fiber brick on a sand cushion and a 5″ concrete base, with asphalt filler.

We have not yet made all of the awards for work which will be completed this year, but from the present outlook the approximate quantities and the cost of these four standard types, including the necessary excavation and curb and gutter is as follows:

	SQUARE YARDS	COST
Concrete	59,045.65	$162,339.10
Asphaltic concrete	31,202.23	100,414.43
Sheet asphalt	14,566.92	67,414.82
Brick	22.661.67	99,698.78
Total	127,476.47	$429,557.13

Houston, Tex. J. C. McVea, City Engineer.

Under our system of handling this work we can not say definitely what work will be done. Most of the paving is initiated by the property owners under petition. The city bears the cost of paving street intersections only. The City has voted $250,000.00 to pay for its part of paving, but the bonds have not yet been sold.

The construction of paving for the year will probably run near 80,000 sq. yd., and will consist of 2″ bitulithic, 2″ Uvalde rock asphalt and 3″ vertical-fiber brick on 6″ cement-concrete foundation. The larger part of the work will probably be bitulithic with Uvalde rock asphalt second, and brick but a small percentage of the total.

The latest paving bids show a slight reduction under prevailing prices for the past year in the three principal items of excavation, base and surface.

THE VALUE OF PRESENT TESTS FOR GRANITE IN DETERMINING THE PROBABLE WEAR IN PAVEMENTS

Clarence D. Pollock, Consulting Engineer, New York City

In studying the present tests for granite in determining its suitability for paving blocks it may be well to study the history and development of these tests.

At first no tests were made, but the blocks were cut, paved and simply submitted to the service test. Architects had required the test for crushing strength of granite which was to be used in building construction. Some of the engineers thought that a test should be called for and knowing of the architects' test, they inserted this in the specifications. Various minimum requirements were used varying from 15,000 lb. per square inch up to even 30,000 lb. per square inch. When the minimum requirement was much over 15,000 lb. it was found that many granites which had proved very satisfactory under the service test for long periods were barred out. A study showed that no very definite relation could be found between this test and the behavior of the granites under the actual traffic conditions. In 1915 this Society adopted specifications with tests for impact or toughness and the abrasion test for French coefficient of wear, including minimum requirements for moderately heavy traffic and heavy traffic.

At that time these tests seemed about as fair as any which had been tried, altho they were not devised for this purpose. Since then, from observation of results obtained in laboratories and results in the pavements, it has been difficult to find much relation between these tests and the actual service test in the streets.

These two tests were designed to measure the relative resistance to impact and wear of broken stone for use in macadam road pavements, and they do not fit in with the conditions surrounding the use as paving blocks, to any great degree.

The object of this paper is not to advocate the abandoning of all tests, but to encourage experimental study for the developing of more practical tests by calling attention to the defects of those now used in the testing of granite for paving blocks.

In the toughness test the sample is very small, one inch diameter and one inch high, and great care is necessary in making the sample or there will be wide variation in results. A little carelessness in making the test specimens from the same sample may result in an error equivalent to 25 percent of the total range of all granite used in the Eastern portion of the United States. This chance for error detracts greatly from the value of the toughness test aside from the fact that it is a test that does not approximate the wear conditions in the street.

In the test for French coefficient of wear also the error may be as great as 25 percent of the total range of the granites, due to the method usually used in breaking the test pieces with a hammer, which may start incipient fractures and also because of the irregularity of the shapes of the pieces for the test.

The Bureau of Public Roads has developed a machine for breaking out the test pieces by pressure which obviates the fault of incipient fractures and produces more regular shapes, but this cuts down the range of results on the various granites and makes it more difficult to differentiate the various granites.

This test does, however, show whether there is any real disintegration or not. The old idea that discoloration indicated disintegration has been thoroly exploded. Discolored or "sap" stone may in many cases show a greater strength than the clear stock from the same quarry. Real disintegration will show up in this test and herein lies its chief value in giving the relative strength of the material from the same quarry, although it is not of much value beyond this in indicating how it will wear when paved in the street.

With the object of improving the present test for French coefficient of wear for granite block pavements the laboratory of the Bureau of Public Roads has made modifications in the methods of preparing the test pieces for the Deval abrasion test as previously stated, the samples being broken into small cubical blocks by means of a machine instead of by hand. The machine consists of a 20-ton forcing press such as is used in automobile repair shops for forcing the gears from shafts. This press is equipped with both stationary and movable knife edges and it has sufficient power to break a standard 5-inch granite block. This machine breaks the block into small cubes rapidly and much more accurately than can be done by hand and in addition avoids the danger of starting incipient cracks in the stone. In other words the test pieces have good clean fairly regular faces and are approximate cubes.

Abrasion tests upon these fragments showed a greater coefficient of wear than the old method, but the results checked much better, altho the range in values obtained with the different granites was much more limited than with the hand-broken specimens. In order to increase this range, Mr. Jackson tried a modification of the abrasion test which was proposed by Messrs. Scofield, Mattimore and others, as follows: a number of longitudinal slots $\frac{1}{16}$ of an inch each in width were milled in the abrasion cylinder, and the test was run on granite from 12 representative quarries making 2 to 3 tests on each kind of granite. Tests were also run on these same granites using the present method, and the results were compared. The elimination of the dust cushion gave lower coefficients of wear but the maximum variation of check tests was much less. In general the coefficients of wear were somewhat over two points lower than with the present standard apparatus.

The total number of tests made was not sufficient to draw definite conclusions as to what minimum coefficient should be specified, but the maximum variation in check tests was sufficiently low to indicate that this was a step in the right direction. It is urged that more tests be made along this line and if they prove as consistent as those already made by the Bureau of Public Roads and several other laboratories, it may be possible to select definite minimum requirements to be used with these modifications in this test which will be an improvement on the present standard so that this test may be much more satisfactory than at present. This test is valuable as a means of proving whether a granite is disintegrated to any extent or not.

Several years ago the Bureau of Public Roads constructed 19 sample sections of granite-block pavement from different quarries using different forms of filler and cushion and tested them by an accelerated traffic test, which consisted of a machine having a frame carried upon rails which were parallel and on either side of the sample sections of pavement. These rails were supported firmly by concrete stringer or beams which also formed the sides of the pavement sections being tested. The subgrade was natural earth on a side hill having a gentle slope. Upon the subgrade 18 inches of rammed cinders were placed and then 8 inches of portland cement concrete were deposited. On this foundation were constructed the various cushions and the test sections of granite pavement. In the frame of the testing machine were cast-iron discs having a diameter of 4 feet which ran freely in the frame. This frame was drawn back and forth over the test sections by means of a cable. This is the nearest approach to a service test which has yet been devised. However, it was not possible to draw very definite conclusions from the results obtained as there was more or less settlement of the concrete foundation, probably due to the large amount of cinders underneath it, and the narrowness of the pavement between the concrete foundations of the rails. It would seem as tho some such form of practical test could be devised which would not be so cumbersome or expensive but that the laboratories could afford to use it.

An important point to be borne in mind in devising a better test is not so much how individual blocks will act under the test as how they will act when combined as in a pavement with the usual joint spacing and the different fillers in the joints.

A simple form of accelerated traffic test would be the ideal one and approximations of this are what should be aimed at in securing a more practical test.

In summing up the value of the laboratory tests now used to determine the wear of granites in granite-block pavements the conclusion is reached that the test for French coefficient of wear is the only one of value and the principal advantage of this is to determine if disintegration has progressed sufficiently to render the stone unsuitable for use in pavements, provided the coefficient of the normal clear stock of that quarry is known. The value of this test will probably be increased by using the modifications as were tried by the United States Bureau of Public Roads.

In the test for abrasion it would be advantageous to use the percentage of wear directly rather than the French coefficient as in the lower percentages of wear the equivalent French coefficients change greatly for small percentage changes.

DISCUSSION

Mr. Norton: Some of you have probably noticed the red sandstone used in this City for paving. Where well laid on a concrete foundation this stone has a tendency to wear flat under traffic.

In Buffalo we have much sheet asphalt, but on grades near four percent or more we use this Medina sandstone. Under steel-tired vehicular traffic it tends to wear smooth on top and give equal accommodation in smoothness to the adjacent asphalt.

With the passing of the steel-tired vehicle is it necessary, or even desirable, to have a paving stone of high co-efficient of wear? Is not a somewhat softer stone which will wear slightly more an equally good pavement for present traffic accommodation?

MR. POLLOCK: In regard to granite blocks wearing down, the so-called soft granite blocks and the hard ones will wear down to a smooth surface.

It takes more traffic to wear the hard stones down, but with the bituminous mastic filler in the joints, and flushed over the surface of the pavement, where considerable will stick, it has a tendency to cushion the lower portions of the block surfaces and brings the wear on the high portions and thus facilitates smoothing off the heads of the blocks. It is remarkable how long this bituminous mastic will stick to the surface.

This wearing down of the blocks to a smooth surface is not only done by metal tires, but I have observed that the driving wheels of ordinary pleasure automobiles have a grinding action on the pavement, and I think will wear the blocks to a smooth surface faster than metal-tire traffic.

MR. DURHAM: I wish to express my agreement with what I think is the spirit of Mr. Pollock's paper that the question of careful construction and the accurate dressing of the blocks is much more important than the results of any theoretical tests to which selected samples may be submitted. The questions of tests for wear of granite has only been brought up in recent years and only in our couhtry. Probably the most successful stone-block pavements have been laid in other countries of Europe or South America and in every case the choice of material amounts to using the best available local stone. Whether you are going to get a good stone-block pavement or a poor one rests upon the proper preparing of the material selected and the careful laying with close joints rather than in determining some theoretical results on tests of small specimens.

I had occasion some years ago in the City of New York, in answering various arguments on this subject to test paving blocks from the various sources from which we were able to secure our stone, in comparison with samples which I had received from cities in Great Britain, Germany, and other regions in the United States. Among my samples tested I included one from the worst paved stone-block street in New York. It was this last which showed the highest results in all the tests for crushing, hardness, wear, etc. This sample could have passed any test in any of the specifications proposed to date triumphantly. It was the best material according to the theorists although actually a difficult stone to dress accurately. In other words I believe the adoption of close joints, even heads and careful work in laying are the important items in the construction of a successful stone-block pavement.

MR. SPRAGUE: There was one point in Captain Norton's discussion relating to street grades of which I took particular note. Prior to the advent of the automobile, the limiting grade upon which it was advisable to lay sheet asphalt or other smooth pavements, was ordinarily between 4 and 5 per cent. One of the chief elements entering into the selection of a proper pavement upon streets with a considerable grade was to provide a foothold for horses, and to accomplish this purpose block stone or other similar pavements were laid. With the passing of the horse-drawn vehicle, smooth pavements have been laid on steeper grades than formerly and I believe in the future smooth pavements will be laid upon even steeper grades than they have been in the past.

MR. NORTON: With the elimination of the horse-drawn vehicle and substitution of the rubber tire we shall have more danger of skidding than we had trouble with foothold for horses.

This is especially true in wet weather and in the fall season when there is a smear of wet leaves. We cannot safely ignore this condition, but should provide a less slippery pavement on grades.

REPORT OF COMMITTEE UPON STREET AND SIDEWALK DESIGN

E. R. Conant, Chairman, Manchester, N. H.

In making a study of street and sidewalk design certain fundamental principles are to be considered, the most important being Utility, Appearance, Safety, Drainage and Arrangement. That full advantage can be taken of streets and walks sufficient widths should be provided for traffic and crowns and grades provided that will least impede traffic. The relative position of roadways, walks and parkways enters into the utility and appearance features and the location of trees, lamp-posts, hydrants, poles can be arranged either to mar seriously the appearance of a street or if the posts, railway poles, etc., are of ornamental design, and properly located, the same with trees or shrubbery can add to the general appearance. The type of curbing and method of laying same adds or detracts from the general appearance. The safety features require consideration of safety islands or zones, also for foot traffic the elevation of the curb at crossings should be properly adjusted and with the present fast moving traffic proper curvature of the curb at corners is required. That surface water upon the streets can be properly taken care of, the arrangement and type of catch basins or inlets is important. Again the arrangement and layout of roadways, sidewalks, and grass plats should be considered with a view of widening the traveled roadway area if found necessary to accommodate increasing vehicular traffic.

It might be said that only at comparatively recent date has street and sidewalk design been attempted in a scientific manner for, comparing the dates given in our answers to the questionnaire sent out by the committee, it is noted that, with the exception of recent layouts in the older cities, street design in same is far behind that followed in the newer cities. Not long ago comparatively narrow streets were suitable for horse-drawn vehicles and with the introduction of street car lines, space had to be provided for same, but not until the automobiles came into existence did the engineers and municipal authorities realize that the laying out of streets to care for motor traffic was a real engineering problem that had to be treated in a scientific manner. It is not at all improbable that surface street-car lines, except under certain conditions, will to a very large extent in the near future be eliminated and a new method of transportation will arise which will be of some type of motor-bus and undoubtedly new requirements for roadway area will then be required. Today there are cities and towns located between large cities between which there is a very heavy truck traffic, which are forced to not only design and adopt types of streets for their local needs, but also to provide for the thru traffic. We recognize the fact that types of thorofares for a residential city may differ from those required for a mill or manufacturing city. Again, topography enters into the design of our streets so that it is very difficult if not impossible to recommend fixed types of thorofares that may be wholly standardized, but from the answers received from 60 odd municipalities a very good idea is obtained of the best practice now in vogue and this report attempts to give a brief summary covering various features of street and sidewalk design for various parts of the United States and Canada.

Methods for Determining Widths of Roadways

Considering design of streets, upon what basis can we determine the proper and necessary width for the traveled roadway? Replies to this question show conclusively that the width of roadways should be based on the number of lines of traffic which they must accommodate and, while very few cities report that they give consideration to the density of traffic as an aid in establishing the necessary number of lanes but instead generally allow certain widths for each line of vehicle, yet the committee feels that a study of the present and prospective amount of traffic is very important and urge that more study be made of this particular feature in establishing present and prospective needs for vehicular traffic.

Widths of Lanes of Traffic

Analysis of the replies received would indicate that for each line or lane of traffic a width of from 7 to 8 feet is necessary for motor vehicles parked at the curb and from 8 to 10 feet for vehicles moving. The greater width is for truck traffic, the lesser for automobiles so that for industrial or business sections a somewhat greater average width should be adopted for each lane of traffic than for the residential section. A reasonable width for each moving lane of traffic should be not less than 9 feet and at this time it need not be above 10 feet. For parking vehicles 8 feet is ample. Space for street-car tracks should be from 8 to 9 feet for single track and from 18 to 20 feet for double track.

Widths of Roadway

With the intensity and character of traffic known, the total required width of the traveled roadway is readily ascertained. It is observed that the newer cities of the West, South and Canada have generally wider thorofares than are found in the older cities. For streets where 2 lanes of traffic are required, the width of 18 to 20 feet is pretty well established. For 3 lanes of traffic 27 feet, for 4 lanes of traffic 36 feet, and where a single street-car exists 10 feet is allowed and for a double track 10 to 20 feet.

In the larger cities radial and main thorofares should be provided for and generally the distance between these main thorofares for residential sections should be from 1500 to 2500 feet and for industrial and business sections they can advantageously be laid out for 600 to 800 feet apart, this spacing being the practice carried out in the cities from which the committee received answers to their questionnaire.

Lanes or Back Streets

The adoption of lanes or back streets, especially in residential sections, is of much importance and directly enters into the utility feature. With a system of lanes, especially with a city laid out with the rectangular system, lanes are of special value. The sanitary sewers can be placed in same. Many of the unsightly poles from the street are placed in the back streets, deliveries to residences can be made, collection of garbage and rubbish as well. Garages constructed on the back of lots can be entered from back streets much better than from the front. The widths of these back streets or lanes should not be less than 18 feet and preferably from 20 to 22 feet for they must accommodate 2 lanes of traffic and provide space for poles.

Classification of Streets

Streets in some instances are spoken of as major, secondary and minor streets, in other cases as boulevards, main and minor systems and lanes. When it comes to consider boulevards, local conditions and topography enter into each individual case, and where extensive boulevards are planned the landscape gardener should be a party with the engineer to lay out such. Your Committee does not attempt at this time to standardize the layout of boulevards but submits with this report typical sections of boulevards as adopted in some of the principal cities of the United States and Canada.

Sidewalks

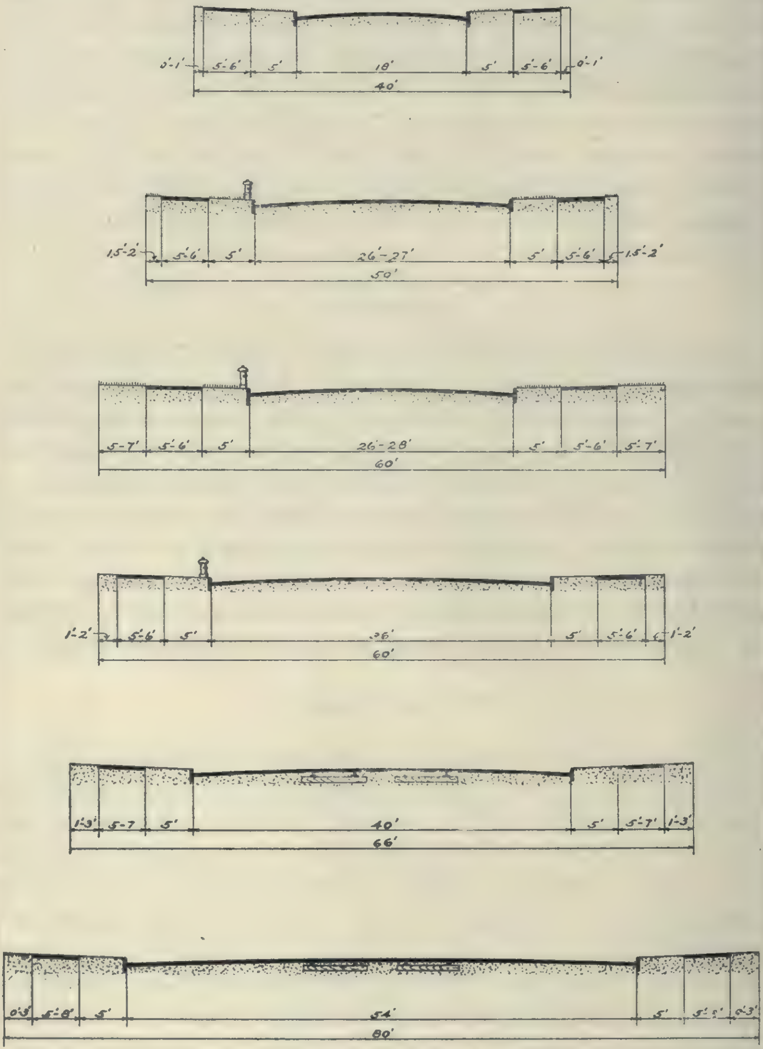
There must be considered the proper width for foot traffic. Sidewalks in many instances in the past have been laid out irrespective of actual or future needs. The width of sidewalks should be determined by the intensity of traffic, and from the replies received the best practice at this time is to adopt a width of from 5 to 6 feet for residential sections, and from 10 to 15 feet or more for business sections, the widest walks being called for in the retail business section. The widths for walks thru parkways are often laid out for appearance as well as to meet actual needs, and the widths noted above are not applicable for these conditions.

Grass Plats

The introduction of grass plats or parking space, especially for residential sections is highly important. Not only does this space offer a suitable location for trees, poles and hydrants, but also it enters into the general appearance of the highway and also affords an opportunity, when properly laid out, to permit of widening of the traveled roadway without the acquisition of additional land. The width of a plat where trees are planted should not be less than 5 feet and the maximum width is fixed for local conditions and by the width of the right of way.

In laying out sidewalks and grass plats a number of cities allot from 1 to 2 feet on unoccupied space between the sidewalk and the property line, that is when the grass plat is next to the curb. In a minority of the cities from which data have been obtained, the sidewalk is placed next to the curb, and the area between the side-

TYPICAL CROSS-SECTION FOR STREET DESIGN



walk and the property line alloted for grass plats; this with a view in some instances of prospective widening of the roadway.

Planning of Streets, Thorofares and Lanes

The general layout of streets, lanes and main thorofares is a study for Planning Boards or Commissions and is more for the City Planning Committee to report upon than Committee of Street Design. After the streets or general location of same are laid out, the width that should be required is for our committee to study, and as noted above this study should be based upon the amount of present and prospective traffic to be accommodated. In many cities widths of streets are determined by ordinances, some of which are long standing, and the dedication of the streets fixes the widths without regard to the amount of traffic which they will be required to accommodate.

Safety Zones

The general practice is to paint the pavement with lines which designate the area or zones where vehicular traffic must give way and look out for foot traffic. These lines may mark zones where street cars stop or they may mark crossings for foot traffic from one sidewalk to the other. The zones where street cars are approached are usually 6 feet in width and of proper lengths and a safety walk from the middle of the zone to the sidewalk on the side of the street where the zone is marked off is advantageous. In a number of cities a raised area way is constructed either by a plank platform about 4 inches high or a platform of concrete. In other localities posts or stands connected with ropes are installed. However, the question of safety islands or zones is a somewhat mooted question and at this time there appears to be no general practice, but in a majority of cases the zones or islands are marked with paint, and in at least one State and perhaps more, laws have been passed requiring safety zones under certain conditions 7 feet in width.

Sidewalk Crossings

There is a tendency to get away from the step at the curb to the street at street intersections, especially where the foot traffic is heavy. In the replies received there were one or two instances cited where the reverse is reported. The method followed out is to have either a gutter underneath a flagging or iron plate with the pavement brought up with a warped surface to meet the curb grade. Another is to have the inlets to catch basins on each side of the corner and the pavement brought up solid to the curb. Where steps are provided, the height or maximum drop should not exceed 6 inches.

Radii of Curbs at Street Corners

Before the introduction of the automobile and motor trucks, when vehicular traffic was carried on with a much lower speed, a 6 or at most 8-foot radius curb was considered adequate. Under present conditions in new layouts the radius of the curb in residential sections should not be less than 10 feet. In business sections, from 10 to whatever limit can be introduced according to width of sidewalk and roadway. For alleys, 5 to 6 feet radius is sufficient. Some cities have established the radii as being equal to the width of sidewalk at the street intersections and where the width of sidewalks is greater on one side than on the other, the maximum width would be taken in determining the adopted radius of the curb. Other cities regulate the radius of the curb by the width of the roadway, the narrower streets calling for a greater radius than wider thorofares.

Catch Basin Inlets

Catch basins should be connected directly to sewer thru manholes, that is, an individual pipe should be carried to the man-hole from each catch basin or inlet and they should never be connected direct to the sewer except at manholes. They are generally located at street intersections but where necessary to increase the number, intermediate inlets may be located in the middle of the block. One reply received from Winnipeg states that the catch-basin inlets are almost entirely located in the center of the block, the grades of the streets being flat. The gutters run to the center of the block and pavement at street intersections is level with the sidewalk. The older systems of conducting water from the gutter into the catch basin was to have gratings in the gutter with narrow slots and perhaps a small opening cut in the curb. Every engineer knows these old type gratings are a nuisance in that they are continually being clogged up and many an overflow has been caused by their becoming unserviceable due to leaves and trash clogging the small openings in the grate bars. Modern practice provides for the entrance of the water into the catch basin thru openings either cut out of the curb or better thru openings in castings set in the sidewalk flush with the curb under which the catch basin is constructed and with steep grades a well constructed grating aids in breaking or stopping the flow. At street intersections there is no reason why more than one inlet should not be carried from the gutter on either side to the one catch basin and with the latter plan, the cross walk for pedestrians can be brought to the level of the curb at the corner. Many cities have the catch basins located at the center of the curb radius. In some cases they are placed on the property line back of the sidewalk but neither plan appears as favorable as to have the catch basins located back of the end of the curb radii.

Crown of Streets

The proper amount of crown is dependent upon the grade, width, and character of paving and to some extent upon the method of providing for run off of water in gutters. Generally the grade varies directly with the width and inversely as a function of the grade of the street. A quite general practice is to fix the crown from 1/60 to 1/100 of the width, depending on the grade and character of service and from the replies received from one or two of the larger cities the crown is frequently the width of the street divided by 60, less one inch. Again in one of the prominent cities the crown expressed in hundredths of a foot is 1½ times the width of the roadway. Another formula noted is to allow ⅜ of an inch per foot for one-half the width of street and another one inch for each five feet of width.

Analyzing the answers in our questionnaire as regards the amount of crown the following appears to be the general practice where grades of streets are normal and where the surfacing of the pavement is concrete, brick, bituminous or surfacing of light nature.

STREET WIDTH	CROWN
	in.
20 to 22 feet	4
24 to 28 feet	5
30 feet	5½
32 to 42 feet	6
45 feet	7
48 to 52	8

For rough-surfaced streets such as granite block the crown should be increased from 20 to 25 per cent, for macadam or gravel 50 to 75 per cent, and where the grades of the street exceed 4 per cent the amount of the crown can be reduced in proportion to the grade, from 20 to 40 per cent.

Gutters

Where very flat grades are encountered the slope of the gutter is often made much steeper than the general crown of the street and in a number of instances cited the slope or rake for the gutter may be as heavy as 1 in. to 3 in. to the foot. This prevents pools of water extending out in the street from the gutter, which might occur if the uniform crown of the street was carried to the curb and especially where there may be slight inequalities in constructing the street surface. Again, a little increase in longitudinal grade or slope in a flat street can be brought about by having this gutter slightly deeper at the catch basin than it is in the middle or end of the block. Attention is invited to a special paper submitted by Mr. Crayton, member of the Committee upon crowns of streets and highways.

Arrangement of Roadway, Sidewalks and Park Space with a View of Prospective Widening of Roadway

Special instances can be cited, but undoubtedly the best plan is where the municipalities have a Planning Board or Commission who with the city engineer or other official having charge of the highways coöperate and have such laws and ordinances passed that only permit the laying out of new streets and thorofares based upon a plan that not only will accommodate present traffic but provide for future growth. In many municipalities such laws and regulations are in force, which fix the building line back from the street line so that if the necessity for street widening occurs, same can be done by acquiring additional land but not requiring the removal or setting back of buildings. Not only is it necessary for the municipalities to have control of the layout of streets within the city limits, but it is very well to have a law which will enable the city to have control of the layout of streets as developed by real-estate agents and land promoters within a certain defined distance outside the city limits; this being done for the reason that as the city limits are extended, there will be a regularity and proper uniformity of layout that will conform to the city's street extensions when the limits are extended. This subject is only touched upon for the reason that the Committee believes that the Committee on City Planning is the proper committee that this study comes under.

The arrangement of parking space and sidewalks can be so carried out that in case the roadway requires to be widened, the extra width can be taken from the park or sidewalk space.

Under certain conditions the sidewalk could be in the buildings, offering arcade appearance. One instance where a paved street was widened without changing the crown or tearing up any of the pavement, and yet not increasing the depth at the curb is of interest. The paving at the new curb line was started at the regular height or distance below the top of the curb and sloped to the edge of the old pavement, making a gutter several feet from the edge of the curb. Before this was done it was thought by some that the method would be undesirable but it worked out so successfully that a number of streets in the same city were widened in this manner. This method appears rather novel but might be used in special cases.

Location of Lamp Posts, Poles and Hydrants

In many cases poles, hydrants or posts are set just back of the curb, but a better practice would be to have them set back from the curb a sufficient distance so that vehicles in parking will not hit them. We know that automobiles have the overhanging tops and when parking upon streets with considerable crown, there is danger of hitting posts or poles if they are not set back a little distance from the curb. This need not be more than 1 or 2 feet. Where park space or grass plats exist, lamp stands or posts are generally set in the middle of the grass plat.

In conclusion, the committee feels that a start has been made in ascertaining what appears to be the most modern and best practice as regards street and sidewalk design.

There are submitted typical cross sections of thorofares in Boston, Winnipeg, Rochester, N. Y., Baltimore, New Orleans and San Francisco. Perhaps another year recommendations can be made bearing directly upon street and sidewalk design, but the work of the Committee this year has been to ascertain what is the general practice and in making their study the members of the Committee have each taken a section of the United States and Canada and a questionnaire was sent out to some 260 municipalities. Answers equaled or exceeded expectations and about 60 cities furnished answers from which the data for this report were made up. The Committee appreciate the interest taken by those who have furnished data.

DISCUSSION

Mr. Pollock: In the report I notice a statement in regard to the advisability of using, in the residential sections of the city, grass plots or parking spaces. In this connection, I think it is very important that the maintenance of this parking should be under some department of the municipality, for its upkeep. If it is left to the individual citizens, especially in a section where the houses are rented largely, the citizens will not keep up this space, for "whatever is everybody's business is nobody's business." I think it adds a great deal to the appearance of a residential section, if properly maintained.

In regard to catch basin inlets, I think it is becoming quite general practice in towns where they are liable to have long dry spells to do away with the catch basins and use inlets.

Mr. Howell: It is pretty hard to criticize a report covering so much ground and as carefully prepared as was Chairman Conant's committee report.

There is one little point which I think he overlooked in his reference to the width of sidewalks in larger cities. I do not recall that he made any mention of how to take care of a sidewalk in a shopping district, as on Forty-second Street in New York City, where an abnormally large number of persons use the sidewalk, not only as pedestrians passing continuously along thereon, but also people examining the window displays of the large department stores. In streets similar to these, having vehicular, and pedestrian traffic far beyond normal, provision must be made not only for an extra width of roadway, but for extra width of sidewalk. Instead of having a sidewalk 15, or 20 feet wide, it may be necessary to provide for a sidewalk 30 feet, or 35 feet in width. The Report is a very comprehensive report and evidences careful preparation.

MR. FOLWELL: A difficulty arises in widening a roadway where you have a sidewalk and a curb. If the roadway is widened to bring the curb to the edge of the sidewalk, in making provisions for automobiles crossing the sidewalk to enter a garage it is necessary to increase the slope of the sidewalk at this point or provide a bridge over the gutter. I should like to ask the speaker what would be the method of handling a situation of that kind. If a depression is made in the sidewalk it is a danger for the pedestrians. If a bridge is constructed it is dangerous to traffic.

MR. CONANT: We failed to send out a questionnaire bearing upon that point, but from my observation I think the general practice is to have the curb lowered to possibly an inch or inch and one-half to two inches above the gutter grade, and then with a rather sharp rise inside the curb so that the vehicles can enter the passageway. That is the practice that I have followed in my work, but, of course, it could be done with bridging directly from the street, but that would be more expensive.

MR. DURHAM: In reference to what was said in regard to catch-basin inlets, it might be of interest to you to know that some fifteen years ago, under the orders of the Chief Sanitary Officer, Colonel Gorgas, it was decreed that there should be no standing water in any receptacle whatever in the city of Panama and as a consequence we were forbidden to introduce catch basins. We adopted in the central portion of the city with the combined sewers, and in some of the outlying districts also, gutter inlets at the corners leading directly to the sewers.

About eight months of the year there is sufficient rain, sometimes excessive rain, so that no nuisance appears. During the dry weather there has been no complaint of smells from any sewer with a fair flow in it. In a few cases, of flat grade and slight flow, flushing has been necessary.

President Rankin: There were two other points in Mr. Conant's paper which appealed to me. One was the proper radius for curb corners which in my judgment in most cities is too short. Our standard used to be six feet but we are increasing it now on the main thorofares. I remember some years ago in Memphis noticing the very sharp corners used there. I don't think they were over two-foot radius, if that, and made of a single stone. The most peculiar feature was that these corner stones were raised above the level of the sidewalk, making a most beautiful place to trip over.

The other point in the paper was the mention made of different styles of catch basins. That seems to be a very much neglected feature in many cities. Some of the basins are very unsightly with unnecessarily large openings, through which a child might fall.

We have in Newark recently adopted a style of basin with inlets at each end of the radius curb, either one or two as the grades require, thus keeping the inlets removed from the corner and improving the looks of the street.

Mr. Norton: Relative to the radius curb, I have found in our Buffalo studies that a vehicle approaching a corner for a right turn is not next to the curb but some distance away and probably turning in not less than a 30-foot radius. If we round our curb corner to a 30-foot radius curve tangent to our curb lines the vehicle would not approach near to it excepting at its apex and such would materially interfere with sidewalk space and arrangement.

We may accomplish the same result by using a compound curve of large radius in its middle part and connected to the curb tangents by small radius-curves, say not over 6 feet, giving the same accommodation to vehicles with much less interference with walk space.

Mr. Laurgaard: I did not hear any reference in the paper to pavements with a concave surface. In Portland as you know, we have what we call the wet season and we find it almost necessary to pave all our streets. In the outlying districts, when the property is of low assessed value, you can see that it is difficult to put in sewers, pavements, curbs, and sidewalks, especially in new districts, because of the low bonding limit.

We have in the last two years attempted a pavement with a concave surface from 16 to 24 feet in width, starting at the curb with a 4-inch drop and then fall of 1 inch to 4 feet toward the center of the street. The catch-basin inlets are then placed in the center of the street in the middle of the block.

For these narrow widths of roadway we use a large radius for the driveways to the garages. By this method we can eliminate the sidewalks until the property has caught up on paying assessments for sewers and pavements. This plan makes it possible for people in these districts to walk to the schools next to the curb where the pavements are dry and the vehicles go in the middle of the street. You realize that this is only for the outlying minor residential streets where there is only slight traffic.

A MEMBER: I did not see that he gave any special emphasis to the necessity for providing for the parking of vehicles in business districts. That seems to me a very important matter, as to the best way of locating the parking, whether it should be on the business streets, or on side streets, and whether it should be on the side of the street or in the center of the street. Those are questions that are coming up both in the laying out of new streets and in the adopting of present conditions of streets to present conditions of motor traffic.

MR. CONANT: The Committee tried not to intrude upon the work and duties of other Committes, and there being a Committee on Traffic Regulations, we assumed that the point you raise would be taken care of by that Committee.

MR. FOLWELL: There is another point that has already been discussed and that is the matter of catch basins. I believe there are times when catch basins ought to be considered, but as a special construction rather than a regular construction, and one reason that I have for thinking that is illustrated by almost any large city. Taking figures for the city of Chicago, we will say in round numbers that Chicago has ten thousand catch basins. A reference to the records of the department having charge of the catch basins will show that they clean between two thousand and three thousand a year. Some need cleaning more than once a year, so at least three-fourths apparently never get cleaned at all.

Of what use are those that are never cleaned? In the first place, the catch basin is so full that it doesn't serve its purpose, and in addition odors will come from it which pedestrians will think come from the sewer, when in reality they are from the catch basin.

A few years ago in Easton, Pennsylvania they built a few inlets without catch basins, and were so well pleased with the results that they employed a gang to go around and fill up all the old catch basins with concrete.

In the city of New Orleans, catch basins are not built at all. I think catch basins in some instances are desirable, but they never are except when they are cleaned out frequently.

Mr. Horner: Up to about ten years ago the city of St. Louis had been putting in catch basins and traps on practically all their street inlets. We came to the same conclusion as did Mr. Folwell that this was an unnecessary expense and that in many cases the catch basins were actually undesirable. During the last ten years, therefore, they have been cut out, except where the sewers are laid on very flat grades, and I do not believe that during this period over five per cent of the street inlets have been built with catch basins. In a few cases where untrapped inlets were put in odors have developed, and it has been necessary to go back and put in basins and traps, but I do not believe this was the case in so much as one percent of the untrapped plain inlets installed.

Secretary Brown: The question of radius curb at the intersections of streets is one to which we have paid considerable attention in St. Petersburg, and we find that it is almost a matter of special design for each intersection. Where we have 100-foot streets and 20-foot pavements there is no question about it, because you have the width of parking space. The automobilist is going to make a wide turn, and if you give him a chance to turn alongside the curb he will take it, but if he has a very short radius to turn in it will be difficult and he must turn out toward the middle of the street to get around the corner comfortably.

In some cases where we have intersections of 60-foot streets with 100-foot streets, we have the difficulty of the long radius curb overlapping the sidewalk. Then it seems to be necessary to put in a shorter radius curb in order to give proper service to the sidewalk on the street which has the narrower parking space so that in each case it seems to be necessary to pick out the radius which is the most satisfactory for that particular place.

In regard to the compound curb: On the right hand side, so that the automobile will be turning to the right around the curb and it is coming off of a wide street, we can put in a large radius curb, which will turn into a short radius curb by the time we get to the sidewalk. On the narrower street, we can then run the narrower radius curb out for the rest of the distance. I do not know exactly how that would be worked, but I can see how the change in radius might aid in turning from the wide to the narrow street. When it comes to turning from narrow to wide street, we have a different proposition.

When it comes to turning into the alleys or driveways into private estates, a curve again is a very desirable thing, and if the turn is across a wide lawn, it is easy to put in as long a radius curb as you like and the property owners are willing to pay for. That makes it much easier for the people who want to use the alleys or narrower streets or driveways into their automobile garages to get into them.

We have decided that we will have no more 10-foot alleys, as they are absolutely useless for our present purposes. We have practically nothing but automobiles to use the alleys. Two of them cannot use the alley at the same time and one must often wait for another in order to get out at all. You cannot get into a garage from a 10-foot alley unless the garage is set back from the alley line with large radius curb on the corner of alley and garage approach, so that our general proposition is that we will have nothing but 16-foot alleys as a minimum, and where we have a 16-foot alley, we will require a 3-foot reservation on each side which cannot be built upon, into which we can put any service in the way of poles, sewers or underground conduits. That gives an opportunity to put a curved curb at the intersection of the alley with each driveway into a garage, and we have an opportunity to use the alley to very good purpose. Really, it ought to be called a narrow street, instead of an alley, because it serves the traffic as such.

I think Mr. Conant's report is very excellent, indeed, because he has covered most of the points which are becoming of very special interest. It cannot cover everything for, it seems to me, there are a good many places where special design is necessary. I called attention to this particular one as an example.

Mr. Corson: Norristown has practically eliminated all catch basins. In many cases there were instances where the catch basins were never cleaned from one year to another. In some isolated points they are so located as to be absolutely useless. Years ago we eliminated the catch basin and put in water-seal traps which are easily cleaned.

In so far as the curb lines or corners are concerned in Norristown, they formerly had the squared corners. Years ago they used a 3-foot or 4-foot radius, and then 6. Now, we use 15 feet and obtain excellent results.

All of our alleys are curbed and paved 3 feet wide with inlets in the center at street intersections and the alleys are uniformly 20 feet wide, making reservations along the sides. In fact, we require all telegraph poles or poles of any character to be located on property lines next to the fence lines to give the people as much freedom of sidewalk as possible.

I would like to ask the speaker from the West, how it is possible to change a street that is made concave, when the demand is made that the improvements be made up-to-date construction—how he then overcomes that obstacle of a concave street.

Mr. Laurgaard: It is not the intention to change the streets. It is laid on a permanent base. If you have a 60-foot street dedicated and you place a 24-foot street in the middle, the only difference is instead of two gutters you have one. When you come to the laying of the sidewalks you lay them of the width desired on the property lines, which leaves very wide parking spaces, creating a very beautiful street for residence purposes. Most of this type of pavements are laid on concrete 6 to 7 inches thick and are on a permanent basis.

President Rankin: Mr. Conant should be congratulated on eliciting so much discussion, particularly as he had a rather difficult subject.

With regard to concave streets, we have a few alleys in Newark which are so paved and instead of the standard covers on manholes, those with large perforations are used. We have no special inlet.

Mr. Pollock: I notice in the report that there has been a variation in radii at the corners in the various cities. I think, in general, most of the cities have multiples of 3-feet radii, and 3-feet lengths of curb. This comes about in case of stone curbs because it requires a very large piece of stock to cut the curved corner with greater length than 3 feet. With this method a 6-foot radius required 3 pieces of curved stone, a 12-foot radius 6 pieces, etc., at most corners meeting at an angle near 90 degrees. If a small number of standards could be adopted it would be an advantage as the curb corners could be cut in advance. I think they could make delivery more promptly.

Secretary Brown: The speaker's experience is that longer radius than 3 feet has been in use generally for thirty years. With automobile travel the tendency is toward lengthening the radius and making it all that the room available will allow. This means that the radii used in a city will depend upon the relative width of pavement and lawn space and the narrower lawn and sidewalk of the two at a corner will fix the radius to be used there.

STREET CROWNS

By G. A. Crayton, Springfield, Ill.

Why crown a street? Drainage. Why shape the crown as we do? Because MacAdam, Telford, the French Road Builders after the Romans, shaped theirs with a flat slope at the center and a comparatively steep slope at the sides. We have all followed the lead of the ancient road builder whose name is lost to us, who first used this shape. There are two principal advantages to this kind of crown: (1) it is pleasing to the eye, and (2) it can be so designed as to give a uniform depth to the run-off.

In some cities it has been found cheaper to remove the street dirt before it has been washed into the sewers. Others are so situated that the storm sewers have sufficient slope to remove such accumulations without deposit in storm sewers. In the first instance we should design our street so that the velocity of the run-off will never be great enough to carry the dirt to the gutters. In the second instance, the velocity should be great enough to carry at least a reasonable amount of the dirt away. In either case, the object sought should be to obtain the proper velocity to accomplish the results desired. The following is offered as an aid to secure such results.

It will be seen at once that a uniform velocity should be secured. The most reliable formula relating to velocity of water flowing in a channel is Chezy's, as modified by Bazin. It may be urged that since this formula applies to open channels, it would not apply to a sheet of water flowing over a street paving.

The formula is

$$V = C\sqrt{sr} \qquad (1)$$

Where V is the average velocity in feet per second.

C is a constant dependent on the condition of the channel and determined by experiment.

r is the hydraulic radius.

s is the slope expressed as a decimal.

$$r = \frac{\text{cross sectional area}}{\text{wetted perimeter}}:$$

If we consider a depth of d over a width of 1 foot,

$$r = \frac{1d}{1}$$

Therefore r varies directly as d. (2)

If we assume that the intensity of rainfall is constant over the area considered, then with V constant, (as we wish to obtain) d will vary directly with the distance from the center line of the paving (3)

Or, combining equations (2) and (3).

r varies directly as the distance from the center line.

Then, at any point, if it is desired to obtain a constant velocity V, C in the formula being constant, the expression $\sqrt{rs}$ must remain constant, or in other words, the cross-section of the pavement should correspond with the equation

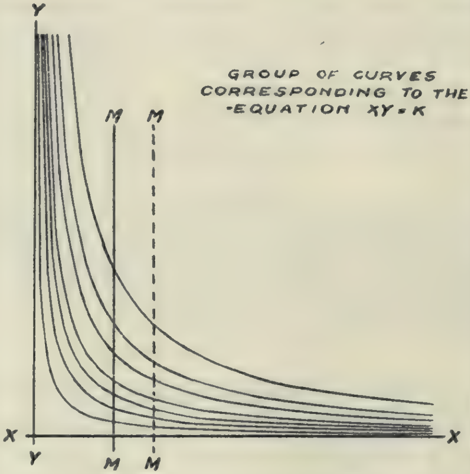
$$rs = k' \qquad (4)$$

But, since we have seen from equation (3) that r varies directly with the distance from the center of the paving, and since the slope s expressed as a decimal represents the tangent of the angle, or vertical distance, we can replace r and s by x and y respectively in the ordinary rectangular co-ordinates.

Then $$xy = K \qquad (5)$$

which is the equation of the equilateral hyperbola. The constant K will depend on the kind and condition of the pavement, the velocity desired and the intensity of rainfall. Plotting up one branch of this hyperbola, and assigning several arbitrary values to K, we obtain a series of curves as in figure 1. The line MM should be shifted to be the center line and the proper value of the constant K selected all to correspond with the particular results desired. Taking the line MM as the center line and making the other half of the section symmetrical, our theoretically correct cross-section would be something like shown in figure 2 B. It goes without saying that such a shaped crown could have but two advantages, a uniform velocity of run-off and an effective separation of traffic lanes. But it is highly impractical.

The form in general use at this time is shown in figure 2A. It is flattest at the center, where the value of r is smallest. Consequently, the flat slope as well as the impossibility of obtaining perfect construction, cause water to stand in the center of most pavements, doing more or less damage. At the same time, in many cases there is so much slope at the edges that driving is difficult. This has led to the practice in many cities where study of the question has been made of using the least possible crown.



— FIG. 1 —

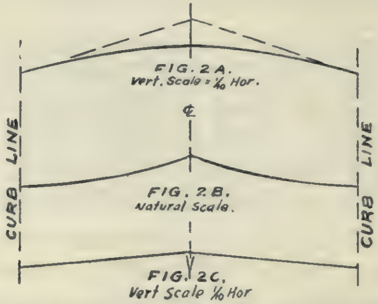


FIG. 2 A. Vert. Scale = 1/10 Hor.

FIG. 2 B. Natural Scale.

FIG. 2 C. Vert Scale 1/10 Hor

SHOWING VARIOUS SHAPES OF CROWNS

This brings us to the recommendation made in former times by J. Walker—that of using two straight lines joined by a short curve (fig. 2C). So far as known to the writer, such a shape has not been used.

It will no doubt be argued that such a crown will be difficult to drive upon. If the planes were very steep, no doubt it would be, especially if attempting to drive in the center of the pavement at high speed. But city engineers in 13 central states replying to the questionnaire propounded by this year's Committee 1-B indicate that they consider from 0.3 percent to 0.5 percent as a minimum grade. Suppose their highest estimate be doubled. On a 1 percent grade, if applied to the proposed cross section, a pavement 50 feet wide would have a crown of 3″, which is considerably less than common practice. It is believed that such a slope would not make driving difficult.

In conclusion, the writer does not offer the suggestion as a panacea for all paving ills. It is desired, however, to call to your attention our present practice of putting the flattest slope where the steepest is needed, and the steepest where not needed. By use of the recommended section, the "rolled" types of paving could be rolled with a little more scientific accuracy. The rollers being nearly true cylinders, there would be less tendency to form waves under these circumstances.

The conservative forces at work in our natures have prevailed against the radical, and we have followed the examples set before us in the past, frequently without question. It might be well to read frequently Sam Walter Foss's poem, "The Calf Path."

REPORT OF SUB-COMMITTEE ON STREET MAINTENANCE

George H. Norton, Chairman, Buffalo, N. Y.

Your Sub-committee C on Street Maintenance would report as follows:

In the report submitted at our last convention, seven points were outlined for consideration. As this was a new committee, it seemed wise to have this work outlined in some tentative form for discussion, that afterward the subjects might be developed into form warranting definite recommendation.

As three of the points outlined in the previous report, C, D, and E, were basic and had no general acceptance among engineers, the Chairman of this Sub-committee presented data at the last convention as a basis of general discussion.

However, the late appearance of our printed report delayed opportunity for such discussion by correspondence to the extent that your Committee is unable to present any definite recommendations.

We believe that the outline of points for consideration should stand as previously submitted and that the future activities of this Society should include the subjects suggested until we may arrive at some general acceptance of basic principles.

The only addition which we might suggest would be toward a standardization of regulations for the opening and repair of openings of improved street pavements.

DISCUSSION

Mr. Laurgaard: I would like to inquire as to what is considered the best practice in the East in backfilling trenches in installation of public utilities under bituminous pavements to permit settlement.

Mr. Norton: I have a report which I thought I might present on that subject of which I can give you a copy if you so desire.

Mr. Pollock: In some cases, where the traffic regulations warrant it, to avoid settlement a small amount of cement has been added to the last foot of material put back into the trench under the foundation of the pavement, in the proportion of something like one part of cement to seven parts of earth or clay material. That is well mixed and it has given very good results. This is in the backfill underneath the concrete foundation.

Mr. Gray: This subject is one of considerable importance to Hamilton at the present time. This is the first season that the regulation has been enforced compelling all connections, water, gas, and sewer services and all street installations to be put in before a new pavement is laid. Our municipal regulations give the property owners 20 days to get in their sewer services. The water services are put in by the city and the gas services by the Gas Company. This is required for vacant lots and consequently on all new pavements we have all sewers installed to the sidewalk line.

This has raised the question as to just what the results will be in the next few years with the paving on these streets. We are safeguarding the situation as far as possible where the ground warrants by wetting the backfilling. In addition to this wire mesh is being used to reinforce the area over the cuts.

After seeing the extent of these cuts my recommendation is that these services be put in about one year in advance of the laying of the pavement. This would mean that the pavement will be somewhat delayed and the property owners might become somewhat impatient, but surely it would safeguard the pavement for which they are paying and lengthen its life.

Mr. Conant: A chief engineer in one of the southern cities had authority granted by the legislature to permit his city to pass an ordinance that when a street was to be paved, all public utility corporations were notified that a street was to be paved within a limit of time, and they were compelled to make all connections to the curb line, and if they did not do it, they could not obtain a permit to open the street for three to five years. That has worked out very satisfactorily. Where an opening would have to be made, the property owners or the public utility corporation had to make a deposit, more than sufficient to put back a pavement in a condition satisfactory to the engineer. The engineer was privileged to make the repairs just as thoroly as he desired. This procedure has eliminated a great deal of the former trouble of having bad depressions.

Mr. Norton: Buffalo has had this plan, of which Mr. Conant speaks, for about forty years where the connections have been extended to the curb. Where it is necessary to make these connections, such having been neglected by the property owners, and is left to the City to do the work, the specifications for such work are attached to and made a part of the paving specifications at unit prices, modified from time to time. Thus it is up to the paving contractor to do this work in the proper way. It has worked out, that one or two firms of plumbers have most of this work, and are very careful with it as they are held responsible for settlement. By making the paving contractor responsible, we obviate trouble in placing the responsibility for these trenches.

Chairman Dutton: The discussion has been quite interesting on the question of maintenance.

It has been our experience in the matter of street maintenance that when cuts are made after the pavement is in, we are not able to get the material back in as perfect a condition as when it was originally laid.

In regard to putting in the connection a year before the paving is laid, this seems to be the better idea, for in most cases the trench would be fully settled and this would probably help to prevent further settlements after the laying of the pavement.

In regard to tearing up the pavements for a period of years, say five years, our requirements are that no connections or openings shall be permitted for two years after the completion of the pavement, but thru personal or political influence, permissions to open the pavements are granted quite often and under such conditions we might as well have the two-year law done away with.

Mr. Norton: It has been well said that it is impossible to prevent this tearing up of streets. If we pass a law of this kind we are only fooling ourselves. We may approach a solution of this problem by charging a flat fee for all pavement openings in addition to replacement costs, and such credited to our repair fund will care for much of the expense of caring for subsequent settlements.

A reasonable solution of the problem would be to make a charge of $25 or $50 for opening a pavement during the first year of its life and reducing this charge by $5 or $10 per year of life until reduced to $5 or $10 for any opening so long as the pavement is maintained.

Mr. Green: We have had considerable experience along this line. We have tried to bond the proposition for utilities and for municipals for opening up our county road system, but the most effective way we have found is to take a cash deposit for opening the street. Of course, the amount varies according to the various kinds of pavements. For macadam, we generally charge about $10, bituminous surface, $50, and for granite block we charge more money.

BITUMINOUS SURFACE-TREATED GRAVEL FOR LIGHT TRAFFIC STREETS

By D. B. Davis, City Engineer, Richmond, Indiana

In the smaller cities often times the choice of a pavement for a particular street is not made according to economic judgment. Especially is this the case in the resurfacing of old roadways, many of which were constructed with excellent foundations, the surface only of these roadways having become deteriorated, often leaving the base course intact, in better condition, perhaps, than many newer ones are constructed.

To the ordinary layman the criterion of a good residence pavement is, that it be smooth and dustless and present a good appearance to the eye. The matter of noise is, of course not an issue, as it was before the advent of rubber tired vehicles. Usually on these three points is the success of the particular pavement judged by the abutting resident. But from an economic standpoint, which is also the engineer's, there are also to be considered the annual cost of keeping the pavement smooth, (maintenance), the annual charge for paying off its first cost and the interest on the investment.

In small cities of from 30,000 to 40,000 and smaller, it is unreasonable to think that all the residence streets could be paved with an expensive type within a short time even tho the property owners themselves were favorable to it, which they seldom are. Consequently it behooves the engineer in charge to provide a resurface for these streets which will approximately give the same service for the light traffic which they bear, as the more expensive type, at much smaller cost. These semi-permanent resurfaces should be smooth, dustless and presentable to the eye and be able to give service to the present traffic until the growth of the city and traffic warrants a more expensive type to be constructed.

Richmond, Indiana, has a population of about 30,000. It is laid out in true Quaker style, with rectangular blocks. Its "Main Street," running east and west, is part of the National

Road Trail. The wholesale and industrial districts are grouped along the Pennsylvania railroad. leaving three sides of the town devoted to residences. The city occupies four square miles in area and is very closely built up.

As there is an abundance of good local gravel, that material was first used in the constructing of its streets some 25 to 35 years ago. The gravel was laid to a depth of 12 inches. In the process of time these gravel surfaces required resurfacing, and it was decided to do this with the local gravel from the city's pit. The gravel which was used showed the following screen test:

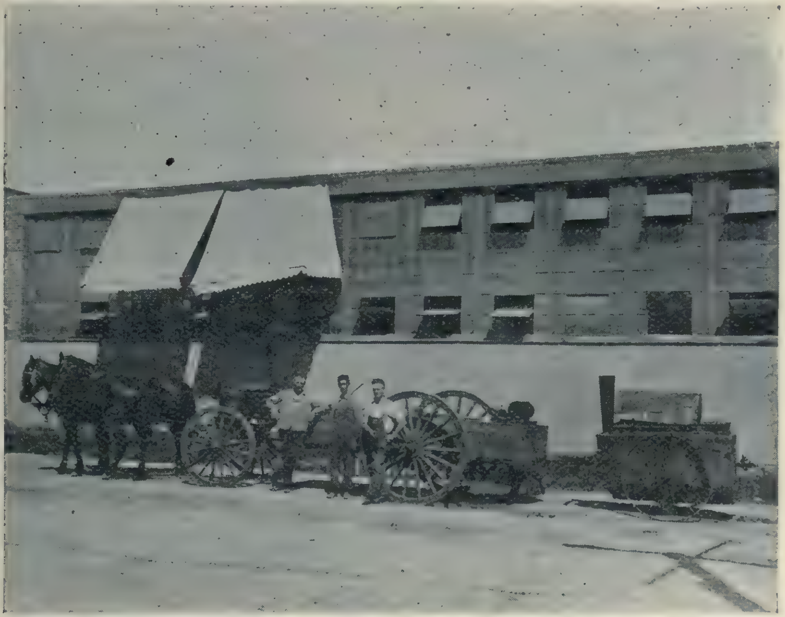


FIG. 1. MAINTENANCE REPAIR OUTFIT FOR MACADAM AND GRAVEL STREETS, RICHMOND, INDIANA

	percent
Passing 1½-inch screen	100.0
Passing 1½-inch screen, retained on ¾-inch screen	11.7
Passing ¾-inch screen, retained on ½ inch screen	6.7
Passing ½-inch screen, retained on ¼-inch screen	16.9
Passing ¼-inch screen, retained on ⅛-inch screen	17.3
Passing ⅛-inch screen, retained on No. 50 screen	29.4
Passing No. 50 screen	4.7
Clay content	13.3

The clay appears as a coating on the pebbles and not as lumps in the mixture.

This new gravel surfacing was spread to a depth of from 4 inches to 5 inches, when it was rolled and water-bound, as in macadam construction. Special care was given to the finishing process of the surface. This was done to more nearly satisfy the abutting residents with the low cost surfacing material. Then in 1919, it was determined to experiment with surface treatments of Tarvia B on these gravel pavements. North 21st Street and North 17th Street were the first ones treated. The success attained on these streets resulted in treating others each year.

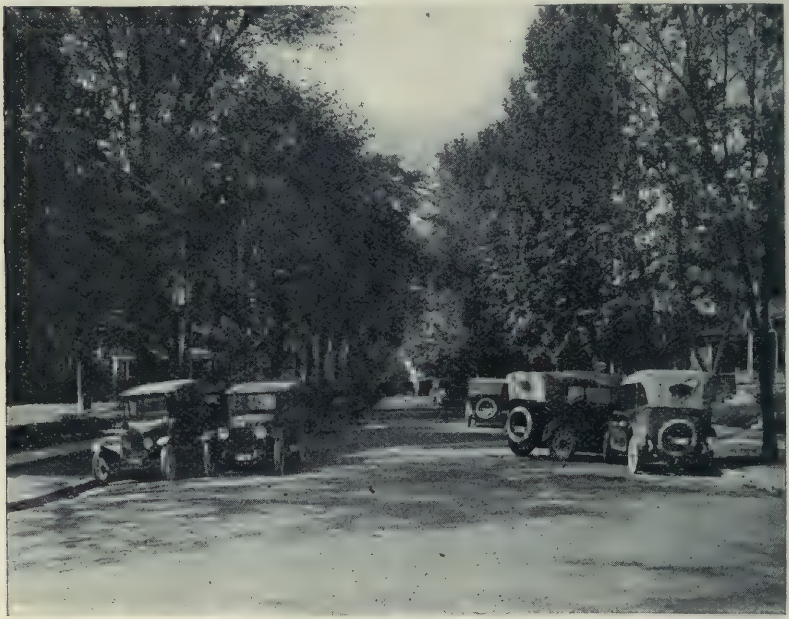


FIG. 2. SOUTH 15TH STREET SURFACE-TREATED GRAVEL STREET DURING BILLY SUNDAY MEETING, RICHMOND, INDIANA

For successful results it has been our experience that the gravel surface must be firm and comparatively smooth prior to the application of the surface treatment. Better results are obtained if the gravel street is subjected to traffic for a season before applying the surface treatment.

The preparation of the surface consists in repairing all depressions by filling the same with $\frac{3}{4}$ inch stone, tamped to about $\frac{3}{16}$ inch below the street surface and sealing them with hot Tarvia.

If there is dust on the surface, it can be removed to the gutter with a rotary sweeper. Otherwise good results have been obtained by applying the bituminous material directly to the gravel.

The Tarvia B was applied cold by means of a pressure distributer. For initial treatment, $\frac{1}{3}$ to $\frac{1}{2}$ gallon per square yard was used, with subsequent treatments of $\frac{1}{3}$ to $\frac{1}{4}$ gallon per square yard. Better results are obtained by not applying any covering material whatever in the initial treatments. This allows the bituminous material to be absorbed by the surfacing gravel, which it does to the extent that, after traffic has ironed it out for a time, investigation shows that a crust has been formed of a thickness of from $\frac{3}{8}$ inch to $\frac{1}{2}$ inch. Subsequent treatments are covered with a light sprinkling of pea gravel, to the amount of about 5 pounds per square yard.

The city street department does the gravel resurfacing and applies the surface treatments with its own forces. The cost of resurfacing with gravel at present prices is approximately as follows:

	Per cubic yard
Cost of bank-run gravel at pit	$0.50
Hauling by teams, 6 loads per day, 1½ yards per load; team at 65 cents per hour	0.72
Spreading on street at 40 cents per hour	0.13
Extra man at pit loading at 40 cents per hour	0.13
Cost of gravel on the street	$1.48

	Per square yard
Gravel delivered and spread at $1.48	$0.33
(5-inch finished depth requires 0.22 cubic yard) Scarifying and rolling	0.07
	$0.40

The cost of the initial treatment of $\frac{1}{2}$ gallon per sq. yd. is as follows:

Gravel covering at $1.50 per cubic yard	$0.005
Binder f.o.b. track at 13 cents per gallon	0.065
Cleaning and application	0.020
Cost of treatment per square yard	$0.090

The cost of subsequent treatments of $\frac{1}{4}$ gallon per square yard is, $0.058 per square yard of surface.

It has been found that after traffic has used the treated gravel street for some months, a few depressions may develop, due either to an excess of dust, or a damp clayey spot on the surface prior to the application of the binder. These places will require looking after. This maintenance work is taken care of here by a maintenance repair gang, consisting of a team hauling a special wagon containing stone and sand, with the necessary tools, and back of which is hauled a tar heating kettle. This wagon was specially constructed for the work, the running gears being from a discarded horse-drawn hook and ladder fire wagon. The wheels are roller bearing, which permits the one team to haul the heavy load. The sand compartment in the rear holds 30 cubic feet and the stone compartment holds 25 cubic feet. Under the driver's seat is a tank for Tarvia B, to be used for very thin patching. The amount of material carried on the wagon will supply stone and sand enough for pouring two barrels of Tarvia X, which is heated in the kettle at the rear. The kettle has a warming rack which holds an extra barrel, over which is a tight hood. The materials thus carried will supply material for the gang for one half day without returning to the store house.

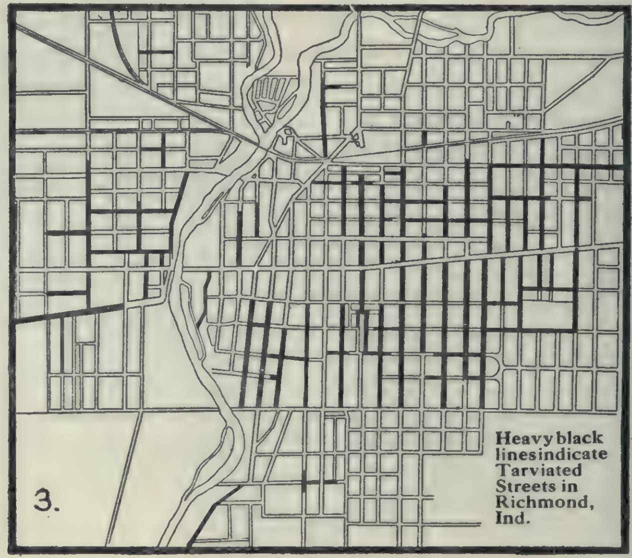

3.
Heavy black lines indicate Tarviated Streets in Richmond, Ind.

FIG. 3.

We have made it a point to keep the surface-treated gravel streets in good repair. This makes the fourth year that we have experimented with Tarvia B on gravel and have secured from that experience somewhat of an idea of the maintenance required to keep them in repair.

Following is a list of a few gravel streets which have received surface treatments.

Street	*Treatments*			
N. 21st Street	1919	1920	....	1922
N. 17th Street	1919	1920	....	....
S. 19th Street	....	1920	....	1922
N. 18th Street	....	1920	1921	....
S. 15th Street	....	1920	1921	1922
College Avenue	....	1920	1921	....
S. 4th Street	....	....	1921	1922
Kinsey Street	....	....	1921	1922

We have been able to figure an average cost for this type of pavement, covering a period of four years, as follows:

Cost of gravel resurface	$0.400
Initial treatment of ½ gallon	0.090
Maintenance first year	0.008
Second treatment of ¼ gallon	0.058
Maintenance second year	0.003
Maintenance third year	0.003
Maintenance fourth year	0.003
Interest on investment at 5 per cent	0.100
Total amount spent in four years, per square yard	$0.665

This does not include any profit, overhead or wear on tools.

Our four years of experience with surface treated gravel has taught us to observe the following points:

Not to apply the bituminous treatment on a gravel surface which is damp or dusty, as it will not incorporate itself with the pavement and will soon break out.

Be sure to apply the treatment uniformly the full width of the street, otherwise it will ravel at the edges.

To have the surface firm and smooth before applying the binder.

Not to apply the binder on any street which has not an adequate foundation, as the binder will not furnish that.

Not to apply the binder on any street unless the treatments will be kept up when they are needed. It has been found here, that $\frac{1}{2}$ gallon per square yard the first year with $\frac{1}{4}$ gallon per square yard the second year, will keep the surface in such shape that no treatments will be necessary for two years. To put one treatment on a gravel street and then leave it alone will make it worse than if no treatments had been applied.

To give the pavements intelligent maintenance.

We have also observed that after the second treatment, the maintenance is no greater than on surface-treated macadam streets.

And that if they are handled rightly, the demand for them on light traffic streets is as much as our forces can conveniently supply.

BUILDING GRAVEL ROADS WITH BITUMINOUS SURFACES

By Philip P. Sharples, Technical Adviser, The Barrett Company, New York City

The surface treatment of gravel roads with bituminous materials is discussed in the papers by Messrs. Sharples and Davis in the Proceedings for 1920. Two years' further experience has confirmed the importance of this class of work both in town and country road problems.

Gravels necessarily vary so much in mineral content and in sizes of particles that the results are not always uniform. It has been found, however, that the methods described are applicable to gravels of widely varying character provided the maintenance and repair are carefully attended to.

The treatment of new gravel roads has received much study in the last two years. Early observations led to the theory that gravel roads should only be treated after wintering followed by the usual spring grading and honing.

The extensive use of gravel roads on much traveled trunk lines and town streets has shown the importance of evolving some method of producing a bituminous surface on a new gravel road. On much traveled roads a new gravel surface is quickly displaced and cannot be made to consolidate under intensive automobile traffic. It was felt that a considerable added expense was justified if these roads could be immediately surface treated.

Early experiments at feeding oils and oil asphalts into gravel had met with little success, since the surface produced continued to wave and rut under use and could never be made smooth and acceptable to modern traffic.

Experiments with tars to be applied cold seemed to give promise of success.

The gravel roads have been built of bank-run gravels which have been proved out thru experience to be good road-building gravels. Only such sizing as could be obtained by a single screening operation has been attempted.

The building operations have been conducted along the usual lines except that the road roller has been very freely used. The gravel has been put on in layers of not over four inches finished, and each layer has been very thoroly compacted. It is absolutely essential that the gravel be a good compacting gravel, but the binding quality must not be gained by an excess of clay. Not more than 15 per cent passing a 200-mesh sieve is permissible, especially in the top course of gravel.

The top course must have good metal in it and at least 50 per cent must be retained on a one-quarter-inch screen and a good proportion must be one inch in diameter.

The tentative specifications following do not go into exhaustive detail as much is yet to be learned of the details of the process. The sizes and quality of the stone particles have not been closely defined as gravels vary so widely in these characteristics that much must be left to engineering judgment until the problem has been more closely defined. Experience has been confined for the most part to New England glacial gravels containing stone of a high coefficient of wear. The sizes of the stone particles are only roughly indicated in the specifications, but it is important that the sizes be well distributed between the limits given. A gravel that compacts to leave a minimum percent of voids is desirable.

The gravel must have good binding qualities with a low clay content. An excess of clay over 15 percent acts injuriously on the tar and also prevents penetration. On the other hand, a gravel deficient in clay will not usually pack and the deficiency must be made up by judiciously adding clay during the compacting of the surface course. No excess of this added clay should be apparent on the surface after completion.

Before the application of any tar, the road must be well consolidated. Traffic has usually been admitted to the road as soon as completed and, up to a certain point, aids in the consolidation of the road. An excess of auto traffic is not allowable and the application of the tar should precede heavy auto traffic.

The tar should be fed into the surface. Usually about four-tenths of a gallon can be applied the first time. This acts as a binder on the gravel but unless quickly followed by the second coat, begins to give way in the weak places in the gravel. The second coat should therefore follow as soon as the hardening of the first coat allows. This is usually in two or three days of warm sunny weather.

The third coat acts as a deferred seal coat and should be put off for several weeks until the road has thoroly hardened and consolidated. It should not be deferred so long that the road shows any signs of general breaking.

Once the road is completed, it is patrolled and maintained like a surface-treated gravel or surface-treated macadam.

The method has given good success where the details have been thoroly carried out. A number of miles have been built in New Hampshire under the supervision of the State Highway Department. Several towns in Massachusetts, among them Hanover and Marshfield have had signal success along these lines.[1]

The specifications following are manifestly only general directions but they are offered with the hope that they will provoke criticism and discussion.

Specification for Construction of Gravel Roads to be Surface Treated on Completion with Refined Tar

All gravel shall be composed of hard durable particles of stone well graded in size and of a good binding quality. The stone shall form approximately three-quarters ($\frac{3}{4}$) of the whole mass.

Sizes. The grading of gravel under these specifications shall be determined by screens with circular openings in accordance with A. S. T. M. specification D64–20T. The sizings shall be designated as follows:

No. 1. All approved material shall contain between sixty-five (65) and eighty-five (85) per cent of metal which shall pass a three (3) inch screen, and be retained on a one-quarter ($\frac{1}{4}$) inch screen.

No. 2. All approved material shall contain between fifty (50) and sixty-five (65) per cent of metal which shall pass a two (2) inch screen, and be retained on a one-quarter ($\frac{1}{4}$) inch screen.

No. 3. All approved material shall contain between twenty-five (25) and fifty (50) per cent of metal which shall pass a one (1) inch screen and be retained on a one-quarter ($\frac{1}{4}$) inch screen.

"Run of bank" material shall contain at least seventy-five (75) per cent of metal which shall pass a three and one-half ($3\frac{1}{2}$) inch screen and be retained on a one-quarter ($\frac{1}{4}$) inch screen.

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[1] See "Reinforcing Gravel Roads for Motor Traffic," by H. L. House, American City Magazine, Volume XXVI, No. 1, January, 1922, and discussion by D. B. Davis, March, 1922.

Subgrade. The subgrade, both on fill and excavation, shall be completed true to the line, grades and cross-sections given on the plans. After all drains have been laid and the subgrade has been shaped correctly, it shall be brought to a firm unyielding surface by rolling the entire area with an approved three (3) wheeled power roller, weighing not less than ten (10) tons. Any portion of the subgrade which is not accessible to a roller, shall be compacted thoroly with hand tampers which shall weigh not less than fifty (50) pounds, and the face of which shall not exceed one hundred (100) square inches in area. All soft and yielding material, and other portions of the subgrade which will not compact readily when rolled or tamped, shall be removed and replaced with suitable material. All loose rock or boulders found in the earth excavation shall be taken away or broken off to a depth of not less than six (6) inches below the surface of the subgrade. In excavation, the ground shall not be plowed or disturbed below the surface of the subgrade except as specified herein.

Base Course. The base course shall consist of "run of bank" gravel placed upon the properly prepared subgrade to the depth called for in the plans. In case more than four inches are called for the gravel shall be laid and compacted as hereinafter provided in layers of not more than four inches completed.

No segregation of large or fine particles shall be allowed and the gravel shall be spread without pockets of fine or coarse material.

When delivered, the gravel shall be dumped along the side of the roadway or on dumping platforms, and not directly upon the subgrade. The gravel shall be spread uniformly on the subgrade with shovels, or directly from vehicles constructed especially for this purpose and approved by the engineer. After the base course of gravel has been laid loose, it shall be rolled with a roller approved by the engineer, weighing not less than ten tons. The rolling shall begin at the sides and continue longitudinally and advancing towards the center. The rolling shall continue until there is no disturbance of material ahead of the roller. After the completion of the rolling, no teaming other than that necessary for bringing material for the next course shall be allowed over the rolled material. If at any time, the subgrade material should become churned up or mixed with the bottom or base course, it shall be removed and the area reshaped and compacted as above specified with acceptable new gravel.

Surface Course. The surface course shall consist of No. 2 gravel laid on the completed base in one (1) course to form a finished depth of four (4) inches.

Material. The material used in the surface course shall be No. 2 gravel, unless in writing the engineer allows No. 3 gravel to be substituted in whole or in part. If the binding material in the gravel is not sufficient to insure the necessary compacting, a suitable binding material may be added and incorporated with the gravel, but the amount of clay or silt added shall not bring the total content of the mixture passing a 200-mesh sieve above fifteen (15) per cent.

Construction. The gravel shall be spread evenly upon the base course to such a depth as to insure the required thickness after it has been thoroly rolled and compacted with an approved roller weighing at least ten (10) tons. Spreading of the gravel shall be done from suitable spreader wagons or from piles dumped along the road as directed or from dumping platforms. No segregation of large or fine particles shall be allowed, but the gravel as spread shall be well graded with no pockets of fine material. The larger stone shall be raked ahead into the bottom of the course and the finer particles of the aggregate kept near the surface. The larger stones shall be uniformly distributed over the surface of the base course. The gravel shall be sprinkled and rolled until it is solid, firm and unyielding to horses' feet, and to wheels. No depressions or surface irregularities shall be left after the rolling is completed. If any depressions occur during the rolling, the compacted material shall be loosened to such depth as is necessary, and sufficient material added to bring the finished surface to the required grade and cross-section. If any clay or silt binder is to be added, it shall be spread evenly over the surface previous to the rolling and sprinkling.

Preparation of Surface of Road for the Application of Tar. If traffic is allowed on the road prior to the application of the tar, all irregularities in the gravel surface shall be planed out by drag or scraper. When thoroly dry, the surface shall be swept to a hard surface with horse or power-driven brooms or hand brooms of stiff fiber material. No traffic shall be admitted to the road after sweeping and before the application of the tar.

Tar. The tar shall meet the following specification:

Water	Not more than 2.00 percent
Specific gravity at 25°/25°C., 77°/77°F	1.14 to 1.18
Specific viscosity, Engler, 50 cc. at 40°C. (104°F.)	10 to 15
Distillation test: Total distillate by weight	
0 to 170°C. (32° to 338°F.)	not more than 7.00 percent
0 to 235°C. (32° to 455°F.)	not more than 18.00 percent
0 to 270°C. (32° to 518°F.)	not more than 28.00 percent
0 to 300°C. (32° to 572°F.)	not more than 35.00 percent
Residue, by weight	not less than 65.00 percent
Specific gravity at 25°/25°C. (72°/72°F.) of total distillate to 300°S. (572°F.)	not less than 1.01
Softening Point (Cube-in-water Method) of residue from distillation test	not more than 60°C. (140°F.)
Free carbon	4.00 to 12.00 percent

The properties enumerated in these specifications shall be determined in accordance with the following methods of test:

Water	A. S. T. M. D 114-21 T.
Specific gravity	A. S. T. M. D 70-20 T.
Specific viscosity	U. S. Dept. of Agriculture Bulletin 691. Results shall be reported as specific viscosity compared with water at 25°C. (77°F.)
Distillation	A. S. T. M. D 20
Softening point	A. S. T. M. D 61
Free carbon	A. S. T. M. D 4

Application of Tar. While the road is still dry, the tar shall be uniformly applied over the surface by means of a pressure distributer. The tar shall be applied in three applications; the first application shall not be less than one-quarter (¼) nor more than one-half (½) gal. per square yard; the second application shall be put on in not less than two days and not more than two weeks and shall be not less than one-quarter (¼) nor more than one-half (½) gal. per square yard. The total quantity shall not be less than three-quarters (¾) nor more than one (1) gal. per square yard. A third application of not less than one-quarter (¼) nor more than one half (½) gal. per square yard shall be applied not less than one month nor more than six months after the initial ones. Prior to the third application, the road shall again be swept and all depressions shall be filled with a mixture of tar and No. 2 gravel well tamped down, using fifteen gallons of tar to each cubic yard of gravel.

Cover. No cover shall be applied after the first application of tar. Immediately after the second application, a layer of clean, sharp, sandy gravel, all to pass a half- ($\frac{1}{2}$) inch screen, shall be spread carefully over the surface of the tar. The third application shall be covered in like manner and the road opened to travel as soon as the surface has hardened sufficiently to resist serious picking up.

PRACTICAL SIGNIFICANCE OF SOME ROAD MATERIAL TESTS

By F. H. Jackson, Senior Assistant Testing Engineer, United States Bureau of Public Roads, Washington, D. C.

In the following discussion the writer desires to call to the attention of engineers who may not be particularly familiar with the technique of highway materials testing some points which should be borne in mind when interpreting the results of test data. It is frankly from the standpoint of the testing engineer and is based on experience in this field, insofar as non-bituminous materials are concerned, for a period of about fifteen years.

The art of testing road materials has by no means attained the perfection of an exact science. Some of the tests now in use were first proposed and adopted many years ago when the necessity for adequate preliminary research was not realized quite so much as it is today. The result is that certain tests have been firmly established by custom and long usage which are admittedly weak in some particulars. The so-called Deval abrasion test for rock and the "tensile strength ratio" determination for concrete sands are typical examples. Because these tests are not technically perfect, however, is no reason why they should not be used. They can be made to serve a very useful purpose, provided the engineer understands wherein the tests are weak and makes due allowance therefor in his interpretation of the results.

The very rapid changes within the past few years in the design and types of pavements in use, caused by changes both in the volume and character of traffic, likewise continually call for modifications in testing methods to meet new conditions. As an illustration of this point the cementation test for rock may be cited. This test was used quite extensively in the days of water-bound macadam road construction but is now practically obsolete. The standardization of tests is at best a slow process and when one considers the frequency with which new conditions arise, it is not surprising that some of our methods of tests have failed to attain the perfection which certain critics seem to expect.

Another point which is overlooked frequently in studying test data is the question of availability of material. Altho this is a matter primarily for the specification writer, experience has shown that many specifications contain requirements which can not be met with any available material. It is well, therefore, that the engineer be familiar with the range in quality, as shown by test results of all materials which could compete with those which he is examining.

Looking at the proposition from another angle, a third essential requirement is that he be familiar with service results obtained with materials similar to those in which he is interested. This particularly applies to such naturally occurring products as rock, sand, gravel, etc. The proper selection of such materials in any case can only be made by studying the test data in the light of all of the service indications which it is possible to obtain. Likewise, in the examination of tests of manufactured materials such as portland cement, paving brick, etc., it is desirable that the engineer know some thing of the previous service and characteristic weaknesses, if any, of the particular product he is investigating. For instance, he may know of a certain mill which may be grinding cement so as just to pass the specifications. He would naturally scrutinize results of fineness tests on this product more carefully than where he is reasonably sure from past experience that the mill is well within the limit.

It will be seen from the above that to pass judgment intelligently on the results of laboratory tests is not quite so simple as might be supposed. Summing up briefly, anyone who would make the best use of such information must know enough about the methods of tests employed to be able to apply reasonable tolerances, he must be familiar with the general character and range in quality of all available materials, and he should know something of the previous service rendered by similar materials in the type of construction involved.

A brief discussion of some of the more commonly used non-bituminous road materials along the lines suggested above follows:

Portland Cement

Portland cement is probably the most universally used of all of the manufactured materials employed in the construction of roads. There is hardly a street or highway of any kind built in which cement is not used, either in the base or surface course of the pavement or in the construction of drainage structures, curbs, etc. The present requirements of the Bureau of Public Roads specify that all cement used in Federal Aid construction must be tested, regardless of the amount involved. Practically all portland cement is now manufactured under the specifications and is tested by the methods prescribed by the American Society for Testing Materials. Several years' experience in testing this material has convinced the writer that altho these methods of tests are far from perfect they are sufficiently accurate, when properly conducted, to detect inferior cement. The words "properly conducted" are used advisedly because there are many laboratories which are unfortunately carrying on routine tests of cement in an incorrect manner. Thruout this paper, however, it will be assumed that the laboratory methods in use conform to the best practice, and that what variations in results are obtained are due rather to inaccuracies in the test itself than to carelessness or ignorance on the part of the laboratory. The present specification limits for portland cement have been set so low, particularly as regards tensile strength, that there should be no difficulty for any standard brand properly manufactured to meet the requirements. For this reason, the writer would be inclined to adhere rigidly to the present American Society for Testing Materials' requirements, except possibly in the case of the fineness test, where a 1 percent tolerance is permissible to cover unavoidable variations in testing.

In this connection it is well in interpreting fineness test results to be sure that a standardized cement sieve was used. Cement No. 200-mesh sieves now on the market are apt to vary as much as 3 percent from the true value. All reports of fineness tests should indicate that the result has been corrected and should give the correction factor. The United States Bureau of Standards will standardize cement sieves for a nominal charge. Results of tests for time of set are usually well within specification limits. Due to the large personal equation involved in this test, no significance should be attached to variations within the limits. About the only value the test has is to detect a flash set. If a flash is reported, however, the cement should positively not be used until it has been thoroly re-tested and found to be O.K.

A word also about the soundness test may not be amiss. A mere report of unsoundness by the laboratory is not sufficient cause for rejection. Unsoundness is caused by the hydration of an excess of free lime, which produces disintegration in the cement by reason of its increase in volume. If a cement showing such unsoundness is stored for a period of two or three weeks prior to use, the chances are that the lime will air-slake and thus become inert. Cements therefore which are unsound when first tested should always be held for a sufficient period to allow this slaking to occur after which they should be re-tested and if sound, accepted for use.

CONCRETE AGGREGATES

The strength and durability of concrete depends fully as much on the character of the aggregates used as on the quality of cement. For this reason a number of tests have been devised and requirements established for both fine and coarse aggregates for the various types of construction.

Fine Aggregates

Fine aggregates, that is, sand, stone screenings, or combinations thereof, are usually subjected in the laboratory to four routine tests: grading or mechanical analysis, silt content, mortar strength, and color test for organic impurities. This is, of course, in addition to tests on the concrete fabricated from the aggregates being investigated. A discussion of the significance of these laboratory tests as they apply to the use of sand for concrete road construction will serve to call attention to some points which are not always appreciated by engineers. The grading of the concrete sand is an important consideration apart from any other test. If the sand is too fine, a weak mortar and a low resistance to wear will be produced. If, on the other hand, it is too coarse, a harsh open mix difficult to work and with a consequent tendency towards the use of too much water will result. The average specification for sand controls the grading within safe limits. The trouble has been that many engineers look upon the test for mechanical analysis as secondary to the strength test and are inclined to waive the former if the strength be within the specification requirement. A knowledge of the relations existing between the various tests would show that many sands much too coarse for satisfactory use in concrete will show very high strength ratios. Results of the strength test under these conditions are very misleading, because of the natural assumption that the higher the strength the better the sand. The point to be emphasized here is that the strength test should only be considered in conjunction with the grading. If this is done, the strength of the sand for any given grading will be an indication of its quality. Thus, for a normally graded concrete sand, that is, one showing about 20 percent coarser than a No. 20 sieve, a strength ratio of 100 percent indicates satisfactory quality. A lower strength is an indication either of the presence of some deleterious substances such as organic matter or that the sand grains are of poor quality. An unusually high strength invariably indicates a very coarsely graded sand. The color test for organic impurities alone is only an indication of danger because there are substances found in concrete sands such as lignite, small particles of coal, etc., which show an unfavorable reaction and are still entirely harmless. If, however, the sand when normally graded shows low strength, the chances are that the substances causing the color are of a harmful nature. If, on the other hand, the normally graded sample shows a low strength and no organic impurities, the trouble is undoubtedly due to poor quality of grains. Tests for silt content are usually positive indications, especially if the determination has been made by weight. Presence of silt in any sand which is to be used in a concrete surface exposed to wear is of course undesirable, for this fine material tends to work to the surface and greatly weaken it. The usual specification allows a limit of 3 percent and in concrete road constuction it is seldom wise to exceed this limit. The term "silt" in this connection is used to cover only the material lost in the elutriation or washing test. It is usually composed of clay, loam or excessively fine sand, considerably finer than a No. 200 sieve. Ordinary fine sand passing a 100-mesh sieve is not harmful in amounts less than 1 percent providing the silt content is low.

Coarse Aggregates

Stone, gravel or slag which is to be used in the construction of concrete pavements should, in addition to being structurally sound, possess sufficient resistance to wear to withstand the abrasive action of traffic. This is particularly true in the case of city streets which are subjected to an appreciable steel-tired traffic. The most commonly applied test for coarse aggregates is the Deval abrasion test. It was designed originally for use in testing macadam stone. The need for some form of test for quality of coarse aggregate led to its adoption for this purpose in spite of the fact that there are many engineers who believe that it is wrong in principle when used in this connection. The test can be applied either to stone, slag, or gravel. The methods of testing, however, are somewhat different, so that the results are not directly comparable. Opinion differs as to the proper test limits to apply when selecting aggregates for pavements. Many concrete roads constructed of stone with a percentage of wear as high as 6.5 or even 7.0 have given good service. As in the case of other materials, however, the best available aggregate should be used and it is for the purpose of comparing available materials that this is of particular value. Altho, as stated above, there is no direct relation between the results of abrasion tests of stone, gravel and slag, numerous laboratory tests have shown that, in general, these materials when of approximately equal quality will show results in the ratio of about 1:3:2. That is, gravel with a percentage of wear of 15 and slag with a percentage of wear of 10 will be of approximately the same quality as stone with a percentage of wear of 5. It will be observed that no reference is here made to the French coefficient of wear. Testing engineers are now practically unanimously in favor of abandoning this term. It really has no added significance, being merely the quotient obtained by dividing the constant 40 by the percentage of wear. It is rather difficult to discontinue the use of the term, however, because almost all highway engineers are accustomed to think only in terms of coefficients. With regard to tolerances which should be allowed when interpreting this test, it is probable that, in general, the test is not accurate to less than 0.5 percent for stone or 1 percent for slag or gravel, the difference being due to the fact that stone is usually more uniform than either of the other aggregates. Such a liberal tolerance is made necessary simply because the test can not be depended upon to give results with any greater degree of accuracy. Many attempts have been made to improve the method but so far none of them has been adopted as standard.

Altho stone may be tested for hardness, toughness, etc., in addition to the abrasion test, the writer believes that the latter is sufficient control when the material is to be used for concrete aggregate. In the case of stone to be used in the construction of bituminous macadam or bituminous concrete roads, however, the toughness test has been found to be of value. In the case of gravel, uniformity of quality is the most essential requirement. This means freedom from soft, disintegrated fragments and an impact test has been developed[1] for determining the percentage of such fragments in a gravel sample. Sufficient data have not as yet been accumulated to permit setting any test limits. For slag, density is the chief requisite. To determine this, a test for weight per cubic foot of crushed slag is made. The usual requirements specify a weight of 75 lb. per cubic foot for pavements. Many good slag-concrete roads have been built, however, with slag running as low as 70 lb. to the foot. It would seem, however, that this is about as low as one should go until further information regarding the use of light slag in pavements is available. The Bureau of Public Roads has constructed and is now testing an experimental concrete pavement in which a large number of samples of stone, gravel and slag of widely varying characteristics are used. The results of this test should throw considerable light on this important question.

The proper grading or size of coarse aggregate will depend on the type of construction. Practice as regards concrete pavements varies in different parts of the country, a maximum size of $2\frac{3}{4}''$ being allowed in many of the eastern states. The chances are that the maximum size is not an extremely important factor provided the aggregate is well graded from coarse to fine. A sample showing anywhere from 40 to 75 percent retained on a screen intermediate in size between the largest and the smallest may be said to be satisfactorily graded. The maximum size of $2\frac{3}{4}''$ which is allowed in Pennsylvania, New Jersey, etc., is largely due to the added cost of further crushing the very hard and tough trap rock quarried in this section. Experience so far seems to indicate that the large stone is satisfactory.

In applying tolerances in connection with results of grading tests, it has been the custom in the past to allow a variation not to exceed 5 percent larger than the maximum size or smaller than the minimum size, which is usually $\frac{1}{4}''$. This is all right in theory but does not work out very well in practice because, as is well known, stone, in general, retained on a $\frac{1}{4}''$ revolving plant screen will often contain as much as 15 percent passing a laboratory screen of the same size. Likewise, the efficient working of some gravel pits requires that the coarse aggregate carry considerable "tolerance" material. Purdue University recently conducted a series of tests to determine to what extent this so-called "tolerance" material was harmful, resulting in the conclusion that as high as 15 percent might be allowed without seriously affecting the strength of the concrete.[2] The principal consideration affecting control tests for grading of aggregates is that the material run fairly uniform from day to day. This is usually determined by testing with a set of field screens right on the job or at the producing plant. One additional point in connection with screen analyses of aggregates should be mentioned. Some specifications call for the material to be the product of the crusher passing a revolving screen with openings of a certain size, say 3″, and to be retained on a revolving screen with openings of a certain size, say 1″. Everyone who has had experience with crushing-plant practice will realize how uncertain such a specification is. There are so many factors which influence the size of a stone product, such as the speed and angle of the screen, amount of moisture on the stone, etc., that the only safe plan is to specify that samples of the products be of definite size as determined by laboratory screens. Knowing these requirements, the quarry man can adjust his equipment so that they can be complied with. It will be found that this is a much safer plan than to be compelled to accept aggregates simply because they were produced in a plant having screens of certain specified size.

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[1] A. S. T. M. Proc. 1922, "An Impact Test for gravel," by F. H. Jackson.

Stone for Macadam

Turning now to stone to be used in macadam construction, we find not only the abrasion test but the toughness test and sometimes the hardness test used in examining the material. In a macadam road, the stone being held in place by a more or less non-rigid binder is not supported on all sides to the same extent as the coarse aggregate in concrete. For this reason there is more chance for the individual fragments to wear in the macadam type and consequently a greater necessity for a tough, durable stone, especially under heavy traffic. The engineer is justified, therefore, in taking only the best available stone and the laboratory may often be of considerable assistance to him in making his selection. Good practice does not in general recommend the use of stone for bituminous macadam where the percent of wear is more than 5.5. The toughness likewise should be at least 6.0. For mixed bituminous concrete, a percent of wear of not more than 5.0 and a toughness of at least 8 is usually required. The type of stone should also be taken into consideration. Many engineers specify a lower percentage of wear for trap or granite than for limestone for a given construction. This is done because the trap and granite are naturally much harder than the limestone, so that a trap showing a percentage of wear greater than normal is likely to be disintegrated or otherwise to be of inferior quality to the limestone, even tho the actual wear as shown by the test is the same. Type is also an important consideration if water-bound or plain macadam construction is used. It is well known that certain types, such as quartzite, gneiss, schists, etc., will not bond on the road and for this reason they should not be used in the wearing course. Simple determination of type of road is all that is necessary in this case, which is partly the reason why the so-called "cementation test" for rock is not now used to any great extent.

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[2] "Permissible Tolerance of Sand in Coarse Aggregates," by W. K. Hatt, Director, Highway Research Committee, Division of Engineering, National Research Council.

Gravel for Surfacing

The testing of gravels for road surfacing is confined largely to a washing test to determine the percentage of clay present, and a mechanical analysis to determine the grading of the sand and gravel from the maximum size down to dust, with the gravel fraction weighing about $\frac{2}{3}$ of the total. Just enough clay should be present to act as a binder. The amount of clay to be allowed will depend on the character of the gravel, ranging from as little as possible in some limestone gravels to as high as 10 to 15 percent by weight in pure quartz gravels. The maximum size will vary with condition but as a rule should not be placed at more than $\frac{2}{3}$ the depth of the course when the gravel is to be used as a base and not more than $1\frac{1}{2}''$ for topping. The tendency recently has been for smaller gravel in the top. In order to control the quality of gravel for wearing course, an abrasion course is sometimes specified. Altho when two or more available deposits are under consideration it is certainly advisable to take the one in which the best grade of stone occurs, it is not usually economically justifiable to reject local in favor of imported material simply on the score of an abrasion test. For this reason the writer would be inclined to waive this requirement under ordinary conditions, provided the material was otherwise satisfactory. Due to the wide range in grading of the average gravel pit, it is essential that rather liberal tolerances be allowed if the road is to be built. For instance, it is hardly practical to reject pit-run material which varies from 50 to 75 per cent retained on the $\frac{1}{4}''$ screen. It is simply impossible in the case of most pits to secure material which will run any more uniform than this. Again, if a specification calls for a 10-percent clay content, some tolerance, say 5 percent, may be allowed. It is seldom wise to allow a clay content in any case in excess of 20 percent.

PAVING BRICK

About the only test to which vitrified paving brick is now subjected is the standard rattler test. This test has been used a great many years and has given, in general, entire satisfaction, altho the writer believes that it, in common with many other tests, can be improved. About the only point to which attention should be called here is the effect of size and type of brick on the rattler loss. It is known that repressed brick will lose slightly less than wire-cut brick of equal quality, due to rounded edges of the former. Likewise, 3″ brick will show a somewhat greater percentage of wear than 4″ brick of equal quality, due to the greater number of linear inches of edges in proportion to weight which are exposed to wear. In the absence of specific data, one would probably be safe in allowing a 1 percent differential in favor of the wire-cut type over the repressed and a 1 to 2 percent differential for a 3″ over a 4″ brick.

Stone Block

Considerable trouble has in the past been experienced in the testing of stone block chiefly because of the attempt to apply the macadam stone tests to this material. The writer has discussed this point a number of times[3] and it will not be necessary to go into details in this paper. Suffice it to say that the Deval abrasion test is not accurate enough to differentiate between the various grades of granite block on the market except in a very rough way. In other words, in using this test, no attention should be paid to a few tenths of a percent variation. The test will indicate the presence of soft, inferior stone and this is about as far as it can be depended upon.

Conclusion

In a paper of this length, it is of course impossible to go very much into the details of this important subject. It is hoped, however, that enough has been covered to indicate the major points to be considered. The object of the paper is to show the necessity of taking certain things into consideration when interpreting test data and when setting specification limits for materials. The fact that these things are not always considered is, the writer believes, the principal reason for much impractical interpretation of laboratory results. It is largely a question of mutual misunderstanding, and the writer sincerely hopes that this paper will contribute at least slightly towards clearing up some of the doubtful points.

[3] "Laboratory Tests of Granite Paving Block and Suggested Specifications," by F. H. Jackson, Eng. & Contr., March 3, 1920.

REPORT OF COMMITTEE ON STANDARD TESTS FOR BITUMINOUS MATERIALS

F. P. Smith, Chairman, New York City

Your Committee on the Tests for Bituminous Materials herewith respectfully submits its 1922 report.

No new tests are included but certain American Society for Testing Materials' Serial Designations have been changed in order to include revisions and changes made during the past year.

For convenience, the complete list of the Standard Methods adopted to date by the American Society for Municipal Improvements is given below:

Specific gravity of road oils, road tars, asphalt cements, and soft tar pitches, as described in A. S. T. M. Tentative Standard Method D 70–20T.

Specific gravity of asphalts and tar pitches sufficiently solid to be handled in fragments, as described in A.S.T.M. Tentative Standard Method D 71–20T.

Flash Point (closed), as described in Am. Soc. C. E. Trans., Vol. 82, 1918, pages 1449–1450.

Flash Point (open), as described in A.S.T.M. Tentative Standard Method D 92-21T.

Penetration Test, as described in A.S.T.M. Standard Method D 5–21.

Viscosity Test with Engler Viscosimeter, as described in Am. Soc. C. E. Trans., Vol. 82, 1918, pages 1452–1453.

Float Test, as described in A.S.T.M. Tentative Standard Method D 139–22T.

Ductility Test, as described in A.S.T.M. Tentative Standard Method D 113–21T.

Softening Point of asphalt products (Ring & Ball), as described in A.S.T.M. Standard Method D 36–21.

Softening Point of tar products (Cube), as described in A.S.T.M. Standard Method D 61–20.

Distillation Test, as described in A.S.T.M. Standard Method D 20–18.

Fixed Carbon, as described in Am. Chemical Soc. Journal, Vol. 21, 1899, page 1116.

Solubility of Bitumen in Carbon Tetrachloride, as described in U. S. Dept. of Agriculture Bulletin No. 314, page 30.

Solubility of Bitumen in Carbon Disulphide, as described in U. S. Dept. of Agriculture Bulletin No. 314, page 25.

Organic Matter Insoluble in Benzole (frequently designated in specifications for tar and tar derivatives as Free Carbon), as described in A.S.T.M. Standard Method D 38–18.

The method referred to applies specifically to creosote oil. Where other tar products are being tested, it is recommended that 2 grams be used for determination instead of 10 grams as specified.

Loss on Heating of Oil and Asphaltic Compounds, as described in A.S.T. M. Standard Method D 6–20.

REPORT OF COMMITTEE ON STANDARD TESTS FOR NON-BITUMINOUS MATERIALS

Arthur H. Blanchard, Chairman, Ann Arbor, Mich.

Your Committee on Standard Tests for Non-Bituminous Materials herewith respectfully submits its 1922 report.

Your committee recommends that the Society adopt methods of testing non-bituminous materials which have given useful, satisfactory and reliable results. It further considers that it is highly desirable that methods of conducting different tests in different laboratories should be as uniform as possible. Hence, it is obvious that, as far as practicable, methods of testing adopted by national organizations should be identical. Based on the above hypotheses, your committee has given careful consideration to the tests adopted by the American Society for Testing Materials, and those proposed by Committee C-9 on Concrete and Concrete Aggregates and Committee D-4 on Standard Tests for Road and Paving Materials of the American Society for Testing Materials and by the Special Committee on Materials for Road Construction of the American Society of Civil Engineers.

At the 1921 Convention, the Society adopted the report of your committee which recommended that seventeen specified tests be tentatively adopted by the Society until the 1922 Convention. Your committee requested in its 1921 report, that criticisms and suggestions relative to the recommended tests be submitted to the chairman prior to July 1, 1922. No criticisms or suggestions have been received by the committee. Your committee approves the recommendations, as embodied in the 1922 annual report of Committee D-4 on Standard Tests for Road and Paving Materials of the American Society for Testing Materials, to substitute two new tests for the following test relative to Quantity of Clay and Silt in Sand for Highway Construction and Workability of Concrete for Cement Concrete Pavements and hence withdraws these tests and hereafter recommends that the substitute tests be tentatively adopted.

Your committee now recommends that the Society adopt the following fifteen methods of testing, heretofore mentioned, as standards of the Society:

Apparent specific gravity of sand, stone and slag screenings, and other fine non-bituminous highway materials, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 715–718, and designated D 55–19.

Apparent specific gravity of coarse aggregates, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 713, 714, and designated D 30–18.

Mechanical analysis of sand or other find highway material, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 721, 722, and designated D 7–18.

Mechanical analysis of mixture of sand or other fine material with broken stone or broken slag, as described in the Am. Soc. Test. Mat., 1921 Standards, page 724, and designated D 19–16.

Mechanical analysis of broken stone or broken slag, as described in the Am. Soc. Test. Mat., 1921 Standards, page 723, and designated D 18–16.

Abrasion of road material, as described in the Am. Soc. Test. Mat., 1921 Standards, page 710, and designated D 2–08.

Toughness of rock, as described in the Am. Soc. Test. Mat., 1921 Standards,, pages 711, 712, and designated D 3–18.

Crushing strength of rock or slag, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, page 1442.

Cementation of rock, slag, and gravel powders, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, pages 1441, 1442.

Quantity of clay and silt in gravel for highway construction, as described in the Am. Soc. Test. Mat., 1921 Standards, page 719, and designated D 72–21.

Organic impurities in sands for cement concrete, as described in the 1921 Report, Com. C–9, Am. Soc. Test. Mat., page 12, and designated C 40–21 T.

Tests for portland cement, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 530–547, and designated C 9–21.

Compression test of cement concrete, as described in the 1921 Report Com. C–9, Am. Soc. Test. Mat., pages 6–11, and designated C 39–21 T.

Paving brick rattler test, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 567–574, and designated C 7–15.

Absorption of water by wood blocks after treatment, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, page 1447.

Your committee recommends that the Society tentatively adopt, until the 1923 Convention, the following methods of testing:

Decantation test for sand and other fine aggregates, as described in the 1922 annual report of Committee D-4, Am. Soc. Test Mat., and designated D 136–22 T.

Consistency of Portland cement concrete for pavements or for pavement base, as described in 1922 annual report of Committee D–4, Am. Soc. Test. Mat., and designated D 138–22 T.

Sampling stone, slag, gravel, sand and stone block for use as highway materials, as described in the Am. Soc. Test. Mat. Proc., Vol. XX, Part I, 1920, pages 789 to 795, and designate D 75–20 T.

Mechanical analysis of subgrade soils, as described in the 1922 Annual Report of Committee D–4, Am. Soc. Test. Mat., and designated D 137–22 T.

The committee requests that all Specification Committees and members of the Society interested in tests for non-bituminous materials give careful consideration to the tentative methods recommended and submit to the chairman of the committee, prior to July 1, 1923, criticisms and suggestions relative to the proposed methods of testing, in order that the next convention may be in a position to adopt, as standards, the four tentative methods of testing referred to in this Report.

Your committee believes that the primary function of the Special Committee on Standard Tests for Non-Bituminous Materials, is to serve the Society as a committee to review new methods and modifications of present methods of testing non-bituminous materials and to recommend to the Society, from time to time, the adoption of standards and changes in such standards as may seem desirable.

THE SEWAGE TREATMENT PROBLEM IN THE UNITED STATES FROM THE STANDPOINT OF SLUDGE

A Progress Report by Langdon Pearse, Chairman of General Committee on Sewerage and Sanitation, Chicago, Ill.

The purpose of this report is not to present anything novel, but to summarize briefly the conditions existing in the sewage treatment works of the cities of the United States with populations of 25,000 and upwards, indicating the methods used and the results obtained from the standpoint of sludge. Further, the need of agricultural study and quantitative growing tests by soil and plant experts is necessary.

The material contained herein has been compiled for the joint use of the American Society for Municipal Improvements, and of the Sludge Committee of the Sanitary Section of the American Public Health Association.

The data given herein are compiled from a questionnaire sent out to over 700 cities and towns in the U. S. At first it was thought possible to obtain information from all plants in towns from 1,500 population and up. Only some 80 replies being received, attention was concentrated on the larger cities with 25,000 population and up. From a few of these data are still lacking. If members of the Society or others can supply them before publication it would be desirable. All population figures are given of the 1920 census. Thanks are due to the various city and state officials who have generously answered inquiries, for the present completeness of the data.

The 1920 census figures give the following number of incorporated municipalities having the population indicated or more.

NUMBER OF CITIES	POPULATION IN 1920	
	Limit	Total of all
68	100,000 and up	27,429,326
219	25,000 to 100,000	10,340,738
2500	2,500 to 25,000	16,534,489

Of these cities those having sewage disposal works have been listed, and also those with works under construction in each group.

The populations of the cities with sewage treatment works are as follows:

GROUP	WITH SEWAGE TREATMENT WORKS		
	Number of cities	Population of cities	Per cent of total group
100,000 and up	17	8,701,747	31.7
25,000 to 100,000	26	1,232,993	11.9

The populations of the cities having sewage works under construction are as follows:

GROUP	SEWAGE TREATMENT WORKS UNDER CONSTRUCTION		
	Number of cities	Population of cities	Per cent of total group
100,000 and up	3	943,058	3.4
25,000 to 100,000	2	71,709	0.7

TABLE 1

General Data

Cities of 100,000 and Up

CITY	POPULATION 1920 CENSUS	PER CENT SEWERED TO TREATMENT WORKS	SEWERS	NUMBER OF TREATMENT PLANTS	
				In use	Proposed
Philadelphia	1,823,779	0.2	C	1	1
Cleveland	796,841	78.0	C	2	
Baltimore	733,826	73.0	S	1	
Rochester	295,750	87.0	C, S(d)	3	
Providence	237,595	98.0	C	1	
Columbus	237,031		C	1	
Akron	208,435	25–30	C	1	
Atlanta	200,616		C	3	
Worcester	179,754	90–95(a)	C, S(a)	1	
San Antonio	161,379			1	
Dallas	158,976	80±	S	1	
Bridgeport	143,555			1	
Houston	138,276	70(c)	S(b)	2	
Albany	113,344	92	C	1	
Reading, Pa	107,784		S	1	
San. Dist. of Chicago	2,986,000	5.5	C	3	5
Birmingham	178,806	85.4	S	2	

(a) In 1922, 69,813 miles combined, 117.169 miles separate.

(b) Very small amount of combined sewers.

(c) All night soil dumped into sewers reaching Treatment Works.

(d) Irondequoit Plant served by combined sewers.

C = Combined. S = Separate.

TABLE 2

Plant Data

Cities of 100,000 and Up

	AREA PROVIDED ACRES	TYPE OF PLANT		
		Screen	Tank	Filter
San. Dis. of Chicago:				
Desplaines	26.52	Bar and fine, G.	Activated sludge	
Morton Grove	1.25		Imhoff	Trickling
Calumet	106.4	Bar, G.	Imhoff	
Philadelphia:				
Pennypack Creek	6.0	Bar	Imhoff	Trickling
Cleveland:				
Westerly		Bar, G.	Imhoff	
Easterly		Bar, G.		
Baltimore	468.08	Bar	Hydrolytic	Trickling
Rochester:				
Irondequoit	315.0	Bar and fine, G.	Imhoff	
Brighton	22.0	Bar, G.	Imhoff	Trickling
Charlotte	0.7	Bar, G.	Imhoff	
Providence		Bar	Chemical	Precipitation
Columbus	30.0	Bar	Imhoff	Trickling
Akron	60.0	Bar, G.	Imhoff	Trickling
Atlanta:				
Proctor Creek	19.0	Bar, G.	Imhoff	Trickling
Intrenchment Creek	30.0	Bar, G.	Imhoff	Trickling
Peachtree Creek	116.5	Bar, G.	Imhoff	Trickling
Worcester	100.0	Bar, G.	Chem. prec. sedimentation	
Birmingham:				
Valley Creek			Septic	Contact
Ensley			Sedimentation	
San Antonio		Irrigation by Contract		
Dallas	100.0	Bar, G.	Imhoff	
Bridgeport		Fine screen		
Houston:				
North Side	3.0	Bar, G.	Activated sludge	
South Side	1.5	Bar	Activated sludge	
Albany		Bar, G.	Imhoff	
Reading			Septic	Trickling

G. under third column indicates grit chamber.

The data collected have been general, as well as applied to the sludge problem. For all cities over 25,000 the data have been tabulated, divided into the two groups.

Group 100,000 and Up

Tables 1, 2 and 3 show the data, classified by general plant and engineering for the group over 100,000. Most of the cities have

TABLE 3

Engineering Data

Cities 100,000 and Up

CITY	WATER USE (GAL. PER CAP.)	SEWAGE TREATED (MIL. GAL. 24 HOUR)		SUSP. MATTER (P.P.M.)	
		Average	Maximum	Raw	Applied to filters
Philadelphia:					
Pennypack Creek	200.0	1.25(a)	2.0	60	30
Cleveland					
Baltimore		46.6	66.6	252	75
Rochester	90				
Irondequoit		32.6	66.2	173	82
Brighton		1.18	1.86	150	29.4
Charlotte		0.27	0.56	460	149
Providence	79.5				
Columbus	86	22.6	36.0	218	108
Akron	90 to 100(b)	8.0	0.15		
Atlanta	90				
Proctor Creek				328	46
Intrenchment Creek				140	44
Peachtree Creek				145	59
Worcester	83.5	21.2	48.9	174(c)	
San Antonio					
Dallas		6.3			
Bridgeport					
Houston	70				
North Side		6	9.0	(d)	
South Side		1.8	2.5	200	
Albany		14.3	19.9		
Reading		6.2		132	96

(a) Average 9 years.

(b) 25 to 30 per cent of population is treated.

(c) Day 278 p.p.m., night 151, effluent plain sedimentation 200 p.p.m.

(d) p.m. in 1920, 174; 1921, 342; 1922 to May 19, 542.

combined sewer systems. Tables 4 and 5 show the data on amount of screenings and grit, and on sludge from Imhoff tanks. Table 6 gives data on miscellaneous sludges.

TABLE 4

Amount of Screenings and Grit

Cities 100,000 and Up

CITY	SCREEN OPENINGS (INCHES)	SCREENINGS (CU. FT. PER MIL. GAL.)	GRIT (CU. FT. PER MIL. GAL.)
Philadelphia:			
Pennypack Creek........	$\frac{3}{4}$	4 (a)	2
Cleveland:			
Westerly................			
Easterly................			
Baltimore................	1	3.25 (e)	
Rochester................			
Irondequoit.............	3, $\frac{1}{16}$ x 2, $\frac{1}{8}$ x 2	5.17 (b)	1.81 + 1.90 (x)
Brighton................	$\frac{11}{16}$	5.17 (a)	0.73
Charlotte................	$\frac{11}{16}$	(a)	
Providence................	3	(a)(d)	
Columbus................	1; $\frac{1}{2}$	1to2 (d)	1.7
Akron....................	2	0.15 (a)	9
Atlanta:			
Proctor Creek Intrenchment Creek Peachtree Creek	1$\frac{1}{2}$ c. to c.	(a)	5.4 to 16.2
Worcester................			2.7
Dallas....................			
Bridgeport................			
Houston:			
North Side..............	1	3.25 (a) (c)	
South Side..............	1	2.93 (a) (c)	
Albany....................		0.21	3.0
Reading..................		(y) (c)	
San. Dist. of Chicago:			
Desplaines..............	1, $\frac{1}{16}$ x 2		
Calumet..................	1		

(a) Buried, (b) Dumped, (c) Burned, (d) Spread on land, (e) Sold to farmers.

(x) 1.81 at plant, 1.90 before reaching plant, (y) 355 lb. per mil. gal.

The inquiry also shows that in the operation of the plants, with the exception of Baltimore, practically no complaints are found, either on the plant itself or the sludge disposal.

Table 7 shows the methods of sludge disposal. With the exception of Cleveland and Providence, practically all of the cities making air-dried sludge dump it on land. Cleveland dumps liquid sludge in Lake Erie. Providence dumps liquid sludge at sea. Five cities lagoon sludge. One plows some liquid sludge into the ground. Four discharge sludge at flood in the river, as opportunity offers. Two have actually tried heat drying.

TABLE 5

Sludge Data, Imhoff Tanks

Cities 100,000 and Up

CITY	LIQUID SLUDGE		NUMBER AIR DRYINGS PER YEAR	MOISTURE PER CENT ON REMOVAL FROM BEDS
	Cu. yd. per mil. gal.	Cu. yd. per year		
Philadelphia:				
Pennypack Creek	0.8	328 (a)	3	
Baltimore				
Rochester:				
Irondequoit	2.5 (b)	29,704	13	49 to 62
Brighton	1.03	444	6	56
Charlotte				
Columbus	11.5	45,000	6	30 to 40
Atlanta:				
Proctor Creek Intrenchment Creek Peachtree Creek			Every two weeks	15 to 25
Worcester	6.95			
Dallas			Every week	
Albany	1.06			

(a) Nine year average.

(b) The amount drawn corrected for storage gives the 1921 accumulation as 1.45 per mil. gal. and 17,329 c.y. for year.

Table 8 shows the use of the sludge by farmers. Three report no use. Seven cities report some use. Of these six say that the same farmer may call for sludge year after year. Only three report any receipts for the sludge and then only nominal amounts.

The sludge analyses reported for Imhoff or other settling tanks (Table 9) all show low nitrogen, ranging from 1.25 to 3.3 percent on a dry basis. The other soluble ranges from 4.6 to 20 percent. The activated sludges reported (table 10) have a much higher nitrogen content.

Group 25,000 to 100,000

Tables 11, 12 and 13 show the data, classified as general, plant, and engineering for the group over 100,000. Most of the cities have separate sewer systems. Tables 14 and 15 show the data

TABLE 6

Sludge Data, Miscellaneous

Cities 100,000 and Up

CITY	LIQUID SLUDGE		NUMBER AIR DRYINGS PER YEAR	MOISTURE PER CENT ON REMOVAL FROM BEDS
	Cu. yd. per mil. gal.	Cu. yd. per year		
Settling or septic tank:				
Baltimore (a)	6.39	107,400	3¾	68.7
Reading	2.9			
Chemical precipitation:				
Providence	11.17	116,564		(b)
Worcester	18.9	121,000		

(a) Based on 6 year average.
(b) Sludge when filter pressed had 30 percent moisture.

TABLE 7

Sludge Disposal

Cities 100,000 and Up

	DUMP AT SEA	LAGOON	AIR DRY AND DUMP	RUN OUT AND PLOW IN	INTO STREAM AT FLOOD	DRY
Philadelphia			√			
Cleveland (c)	√					
Baltimore			√			√
Rochester			√			
Providence	√					
Columbus		√	√		√	
Akron			√		(b) √	
Atlanta			√	√	√	
Worcester (a)		√				
San Antonio		√				
Dallas			√			
Bridgeport						
Houston		√			√	√
Albany			√			
Reading		√				

(a) No money appropriated to operate sludge presses since April, 1917.
(b) Major portion of sludge discharged into river.
(c) Dumped into Lake Erie.

TABLE 8

Sludge Use

Cities 100,000 and Up

CITY	HAULED BY FARMERS	USED YEAR AFTER YEAR	MONEY RECEIVED
Philadelphia (a)	Yes	Yes	No
Baltimore (b)	Yes	Some do and some don't	25¢ per load
Rochester	Yes	Yes	75¢ per load of 2 c.y.
Providence	Small amount	No	No
Columbus	Yes	Yes	No
Akron			
Atlanta	Yes	Yes	Contract
Worcester	Some	Some	No
Dallas	No		
Bridgeport			
Houston	No		
Albany	No		
Reading	(?)		

(a) 9 year Average.

(b) Received from $374.47 to $2689.94 per year from farmers and from sale to fertilizer company.

TABLE 9

Sludge Analysis as Reported for Imhoff and Other Tanks

Cities 100,000 and Up

CITY	SP. GR.	PER CENT DRY BASIS				
		H_2O	Volatile	Fixed	Nitrogen	Ether soluble
Philadelphia:						
Pennypack Creek	1.065	85.0	41.0	59.0		20.0
Baltimore (a)	1.020	91.6	74.0	26.0	2.64	9.0
Rochester:						
Irondequoit	1.025	89.0	44.0	56.0	1.95	6.0
Brighton	1.03	81.2	35.0	65.0	1.82	8.4
Charlotte	1.02	84.0	41.0	59.0	1.7	7.1
Columbus	1.02				1.2	
Akron						
Atlanta	1.02		39.0	61.0	1.25	6.1
Worcester (b)	1.06	91.9	46.0	54.0	3.3	4.6
Dallas						
Albany	1.04	86.1	45.9	54.1	1.6	6.5

(a) Hydrolytic.

(b) Experimental.

on amount of screenings and grit, and on the sludge from Imhoff Tanks. Table 16 shows sludge data on miscellaneous plants.

The inquiry also shows that in the operation of the plants, with the exception of Schenectady, New Britain, Fresno, Austin (before covering tanks and trapping sewer outlet) and Plainfield, practically no complaints are reported either on the plant itself or sludge disposal.

Table 17 shows the methods of sludge disposal, with the exception of Madison which lagoons, and Fresno, Mansfield, and Plainfield which run sludge out into the fields and plow in. Practically all the cities having air-dried sludge dump it on land. One city discharges at flood into the river. None have tried heat drying.

TABLE 10

Sludge Analysis as Reported for Activated Sludge

Cities 100,000 and Up

PLACE	SP. GR.	PER CENT DRY BASIS				
		H_2O	Volatile	Fixed	Nitrogen	Ether soluble
Worcester*......	1.01	98.06	51 to 74	26 to 49	3.2 to 7.35	1.9 to 9.0
Houston........	1.06	99.6	59 to 70	41 to 30		10

* Experimental.

Table 18 shows the use of the sludge by farmers. Eight report no use. Seven report some use, of these six, five say the same farmer may call for sludge year after year, but one notes that the sludge is not used on the same land. Only one city reports any receipts for sludge, and that only $2.00 per cubic yard. This is the highest rate of sale reported.

The sludge analyses reported (table 19) on the Imhoff and settling tanks all show low nitrogen, ranging from 1.21 to 2.6 percent on a dry basis. The ether soluble content ranges from 2 to 7.5 percent on a dry basis. The electrolytic sludge from Allentown is very low in nitrogen, because of the lime used, and is even higher in fixed solids than the Worcester sludge (table 20).

Comparative Analyses

Thru the courtesy of Mr. H. P. Ramey, Acting Chief Engineer, The Sanitary District of Chicago, and Dr. F. W. Mohlman, Chemist, we present herewith table 20, showing analyses of typical sludges, shipped in from the various plants shown, and analyzed in the laboratory of the Sanitary District. This table shows more clearly the variation of nitrogen content in the different types of sludge. The activated sludge of the Corn Products Refining Co. testing station at Argo shows up the highest, with the domestic activated sludges next in amount.

TABLE 11

General Data

Cities 25,000 to 100,000

CITY	CENSUS 1920	PER CENT SEWERED TO TREATMENT	SEWERS	NUMBER OF TREATMENT PLANTS	
				In use	Proposed
Schenectady	88,723	50	S	1	
Canton, Ohio	87,091	80	S	1	
Allentown	73,502	?		1	
Brockton	66,254	95	S	1	
Pawtucket	64,248			(a)	
New Britain	59,316	80	S	1	
Long Beach	55,593	75	S	1	
Atlantic City	50,707				
Jackson, Michigan	48,374			1	
York, Pennsylvania	47,512	33	S	1	
Fresno	45,086	100	S	1	
Mt. Vernon	42,726		S	1	
Lakewood	41,732	77 (c)	(d)	1	
Woonsocket	43,496	75	S	1	
Lexington, Kentucky	41,534		C	1	
Fitchburg	41,029	93	(b)	1	
Stockton	40,296	100	S	2	
Springfield, Missouri	39,631		?	1	
Madison	38,378	100	S	1	
Stamford	35,096				
Austin	34,876	80	S	1	
Pontiac, Michigan	34,273	90	S	1	
Colorado Springs	30,105				
Marion	27,891			1	1
Mansfield	27,824	90	S	1	
Plainfield	27,700	100	S	1	

(a) Portion of sewage direct to Blackstone R., portion to works of Providence R. I.

(b) Sewers 70 per cent combined 30 per cent separate.

(c) 23 per cent is handled by Cleveland.

(d) 23 per cent of sewer system is combined, 77 per cent separate.

Operating Data

The results of the inquiry show that the plants in the cities of 100,000 and upwards in general have technical attention and in most cases a chemist in charge, even tho money is not always available for continued or complete operation. In the cities from 25,000 to 100,000 only 6 have any complete control. Among the most thoroly operated appear Fitchburg and Plainfield. The rest may have some control by a city official, but not enough to keep any real operating data. One city frankly reports no funds.

TABLE 12

Plant Data

Cities 25,000 to 100,000

CITY	POPULATION SERVED	AREA PROVIDED IN ACRES	TYPE OF PLANT		
			Screen	Tank	Filter
Schenectady	See Table 11.	22.0	Bar	Imhoff	Trickling
Canton		25.0	Bar	Imhoff	Contact
Allentown		0.57	Mesh	Electrolytic	
Brockton		170.0	Bar	Settling	37 ac. sand 2 ac. trickling
New Britain		90.0	Slot		
Long Beach			Slot		
Atlantic City					
Jackson					
York		27.0	Bar	Imhoff	
Fresno		800.0		Septic	Farm
Mt. Vernon				Settling	Trickling
Lakewood		10.0	Bar, G.	Imhoff	
Woonsocket			Bar		Sand
Lexington			Bar	Imhoff	Trickling
Fitchburg		120.0	Bar	Imhoff	Trickling
Stockton:					
North		0.5	R. W.	Chlorination	
South				Imhoff (Chlorination)	
Springfield				Imhoff	Trickling
Madison		40.0	Bar	Separate digestion	Trickling
Stamford					
Austin		20.0	Bar	Imhoff	
Pontiac		16.0	Bar	Imhoff	Trickling
Mansfield				Imhoff and septic	Contact
Plainfield		92.0	Slot	Imhoff	Trickling

Sludge Disposal

From the standpoint of sludge disposal and use, the very great preponderance of air drying and dumping as a means of disposal is of note. Further the lack of interest by farmers and the general lack of income as yet from sludge disposal are noteworthy. For this the low nitrogen content generally prevalent may be responsible. However there is the possibility of lack of publicity. With suitable publicity one of the smaller towns within 40 miles

TABLE 13

Engineering Data

Cities 25,000 to 100,000

CITY	WATER USE (GALS. PER CAP.)	SEWAGE TREATED (MIL. GAL. PER 24 HR.)		SUSP. MATTER (P.P.M.)	
		Average	Maximum	Raw	Applied to filter
Schenectady	158	6.0	9.0	146	34
Canton		5.56	10.02	268	92
Allentown	96 to 192				
Brockton	44	2.75	6.0	206	97
New Britain	70	4		129	
Long Beach	45	3.5	4.75		
Atlantic City					
Jackson					
York	85 to 90	2.75	4.0	110	50
Fresno	300	8.0			
Mt. Vernon					
Lakewood	90	4.0	6.0		
Woonsocket	56	1.5		171	
Lexington, Kentucky		3.0			
Fitchburg	100	2.4	10.0	389	60.0
Stockton	135				
North		1.8	2.95		
South					
Springfield, Missouri					
Madison	100	5.7	10.0	299	98
Stamford					
Austin		2.5	4.5		
Pontiac	110	3.8	6.5	200	5
Marion					
Mansfield		2.5			
Plainfield	100	3.5	4.5	150	60 to 70

TABLE 14

Amount of Screenings and Grit

Cities 25,000 to 100,000

CITY	SCREEN OPENINGS (INCHES)	SCREENINGS (CU. FT. PER MIL. GAL.)	GRIT (CU. FT. PER MIL. GAL.)
Schenectady	1½	(a)	
Canton	1 or ¾	4.02 (c)	0.22
Allentown	¼ mesh	9.9 (a)(c)	4.0
Brockton	1¼	(a)	
New Britain	1/16 x ½	30 (d)	
Long Beach	1/32 x 2	(c)	
Atlantic City			
Jackson			
York	3		
Mt. Vernon			
Lakewood	2	1 (c)	
Woonsocket	1	(b)	
Lexington	2		
Fitchburg		0.95 (a)	4.96
Stockton			
North	3/64 x 2	27.1 (b)	
South			
Madison	1⅜	2.75 (a)	
Stamford			
Austin	¾	1 (a)	
Pontiac	1½–1	3½ (a)	0.75
Plainfield	1/16 x 2	13.5 (a)(d)	

(a) Buried, (b) dumped, (c) burned, (d) spread on land.

TABLE 15

Sludge Data, Imhoff Tanks

Cities 25,000 to 100,000

CITY	LIQUID SLUDGE		NUMBER AIR DRYINGS PER YEAR	MOISTURE PER CENT ON REMOVAL FROM BED
	Cu. yd. per mil. gal.	Cu. yd. per year		
Schenectady			8 to 10	
Canton	13.8	28,126		65
York	2.44	707 to 2820	6.0	65
Lakewood		(a)	2.0	
Lexington				
Fitchburg	5.02	4,514	5.73	46
Pontiac	2.0			
Plainfield	3.1	4,000	7.7	75

(a) 418 cu. yd. per year dried sludge reported.

of Chicago has been selling its Imhoff sludge for several years at $5.00 per load. Chemical precipitation sludge appears to have practically no value.

TABLE 16

Sludge Data, Special

Cities 25,000 to 100,000

CITY	CU. YD. PER MIL. GAL.	CU. YD. PER YEAR	NUMBER AIR DRYINGS PER YEAR	MOISTURE PER CENT ON REMOVAL FROM BED
Allentown	30.0		12	75
Brockton	6.3	7415	2	65
Madison, Wisconsin	27.0			

TABLE 17

Sludge Disposal

25,000 to 100,000

DUMP AT SEA	LAGOON	AIR DRY AND DUMP	RUN OUT AND PLOW IN	INTO STREAM AT FLOOD	DRY
Schenectady		√		√	
Canton		√			
Allentown		√			
Brockton		√			
Atlantic City					
Jackson		√			
York		√			
Fresno			√		
Mt. Vernon					
Lakewood		√			
Lexington		√			
Fitchburg		√	√		
Stockton South					
Madison	√		√		
Stamford					
Austin		√			
Pontiac		√			
Marion					
Mansfield			√		
Plainfield			√		

Steps Necessary

The obvious step necessary to interest the farmer in sludge is the development of a real yardstick of value. For this end the need of intelligent treatment on experimental farms is urged. At the suggestion of Mr. Hatton, the Secretary of the U. S. Department of Agriculture has been requested by various municipalities to allocate part of the budget of his department for a thoro investigation, trying sludges in different parts of the country and on different crops. The experiment stations of the States of Illinois and Wisconsin have been urged by the Sanitary District of Chicago and the Milwaukee Sewerage Commission to cooperate. They have expressed a desire to do so within the limits of their resources. Further the Sanitary District of Chicago is planning to undertake some experimental work in the vicinity of the truck farms around Chicago.

TABLE 18

Sludge Use

Cities 25,000 to 100,000

	HAULED BY FARMERS	USED YEAR AFTER YEAR	MONEY RECEIVED
Schenectady			
Canton	Yes	Yes	No
Allentown	Some		No
Brockton	Yes, tried but abandoned	Not on same land	No
Pawtucket			
New Britain	No		
York	No		
Fresno	No		
Lakewood	No		
Lexington	Yes, 50 per cent	Yes	
Fitchburg	Yes		
Stockton	No		
Madison	No		
Austin	No, too much oil		
Pontiac	Yes, 20 per cent		$2.00 per c.y.
Mansfield	Yes		
Plainfield	Some	One *	

* Grows good corn but use is handicapped by grease. Local board of health prohibits carting or use.

In order to determine all the elements of value trials extending over several years will be needed. Such trials to be effective necessarily must be quantitative. To properly apply the fertilizer and learn its true value, such trials should be under the direction of trained agricultural experts who know what fertilizers and what amounts are requisite for the different trial crops. Dr. Schreiner of the Bureau of Soil Fertility of the U. S. Department of Agriculture recommends trial crops typical respectively of roots, grain, leaf and fruit.

TABLE 19

Sludge analyses as reported

Cities 25,000 to 100,000

CITY	SP. GRAVITY	PER CENT DRY BASIS					TYPE OF PLANT
		H_2O	Volatile	Fixed	Nitrogen	Ether soluble	
Schenectady........	1.000	92.7	70.0	30.0			Imhoff
Canton............	0.997	94.3	5.0	95.0	2.6	3.5	Imhoff
Allentown..........	1.05	96.0	20–30	80 to 70	1 to 0.7	2.0	Electrolytic
Brockton...........	1.01	93.8	85.5	14.5			
York...............		93.0					
Mt. Vernon.........							
Lakewood..........							
Lexington..........							
Fitchburg..........	1.05	87.5	41.0	59.0	1.88	7.2	Imhoff
Madison............					1.21		
Plainfield..........		94.0					

Recommendations

For the following year, the recommendation is made that the committee work be extended to cover some of the smaller cities and to collate the information on sludge use in various countries. The cooperation of the authorities in England and Canada should be sought. Quantitative data may be secured on methods and cost of sludge handling. Operating data should also be available from the Des Plaines River and Calumet Sewage Treatment Works of the Sanitary District of Chicago.

TABLE 20

Analyses of Sludges Received from Sewage Treatment Works

All analyses on dry basis percent

SOURCE OF SLUDGE	NITROGEN	GREASE	VOLATILE MATTER (ORGANIC)	FIXED MATTER (INORGANIC)	NITROGEN IN VOLATILE MATTER
Imhoff Tank					
Fitchburg, Massachusetts	1.71	4.6	35.3	64.7	4.84
Columbus, Ohio	2.04	5.5	45.7	54.3	4.46
Batavia, New York	2.93	3.1	47.0	53.0	6.23
Plainfield, New Jersey	2.91	4.1	50.7	49.3	5.74
Cleveland, Ohio	2.40	1.6	40.3	59.7	5.95
Atlanta, Georgia	1.37	4.8	34.1	65.9	4.02
Average	2.23	4.0	42.2	57.8	5.28
Secondary Tanks Receiving Effluent of Sprinkling Filters					
Fitchburg, Massachusetts	2.25	4.6	43.4	56.6	5.18
Plainfield, New Jersey	3.78	2.6	57.6	42.4	6.56
Average	3.02	3.6	50.5	49.5	5.87
Chemical Precipitation					
Worcester, Massachutts	1.62	1.2	41.8	58.2	3.88
Activated Sludge					
Sewage:					
Milwaukee, Wisconsin	5.82	2.2	67.8	32.2	8.58
Houston, Texas	4.64	7.1	62.9	37.1	7.38
Average	5.23	4.6	65.3	34.7	7.98
Industrial wastes:					
Argo, Corn Products	6.03	1.2	75.3	24.7	8.00
Chicago, tannery wastes	2.18	0.2	49.4	50.6	4.41
Chicago, Stockyards testing station	4.17	6.0	62.6	37.4	6.66

Note: All these analyses were made in the laboratory of the Sanitary District of Chicago.

MR. PEARSE: That concludes the general report of the activities of the Committee. We feel that there is a possibility for the proper use of sludge and in this we are encouraged by the agricultural authorities at the University of Illinois and elsewhere.

They say there has never been proper study made of it in this country and there is yet to be shown the reason why it should not be used. In other words, they suggest that we should go ahead, try it out over several years and learn exactly what can be done with it before we say "Yes" or "No" to the future. That is our position in our Chicago work. We are going ahead to press and dry our sludge in our two smaller plants, one and one-half to two tons a day, bag it and distribute it around to such authorities and try it out on the neighboring truck farms. We have the problem before us just now of improving the grounds on one of our plants. We shall try it out there and have a demonstration of our own as to the effectiveness of this material for promoting good lawns. We figure that if it works we can save several hundred dollars at least.

Further discussion of this paper will be found on page 126.

BRIEF HISTORY OF SLUDGE DEWATERING INVESTIGATIONS AT THE MILWAUKEE TESTING STATION

By T. Chalkley Hatton, Chief Engineer, Sewerage Commission

Since the late fall of 1914, the Sewerage Commission of the City of Milwaukee has been investigating the process of sewage treatment, known as "Activated Sludge." This investigation, as is generally known, has been carried out largely by means of a testing or experimental station in charge of William R. Copeland, Chief Chemist, in which nearly every promising suggestion towards the development of the process has been given consideration and, in many cases, original devices designed and operated.

Early in 1919, the investigation had proceeded far enough to warrant the engineers and the chemists connected therewith to conclude that the process could treat the sewage to any standard required within reasonable expense and to determine the type and size of structures and apparatus for obtaining this result most economically. As the investigations proceeded, it was found that successfully treating the sewage to the required standard but partially solved the problem, the other, and perhaps the larger part, being the disposal of the sludge produced by the process.

The sewage treatment process, as developed upon Milwaukee sewage containing approximately 250 p.p.m. of suspended matters, produces during summer temperatures from 12,000 to 15,000 gallons of sludge per million gallons of sewage containing 2 percent solids, while during winter temperatures, 23,000 to 25,000 gallons are produced containing 1 percent solids. The problem at Milwaukee was to reduce the moisture in this enormous volume of sludge to 10 percent, producing thereby a fertilizer which could be handled commercially. To the engineer conversant with sludge-disposal problems, this appears to be some job.

As early as 1916, methods were tried for reducing the moisture in the sludge from 99 to 80 percent or less. Hydraulic filter presses of two types were used; one was the Berrigan type of press as manufactured by the Worthington Pump & Machinery Corporation and consisted of two platens actuated by hydraulic pressure, forcing the platens against filter bags, 6 ft. by 9 ft., containing the sludge to be dewatered, and the other type was the Simplex, made by the Simplex Ejector Company of Chicago, and consisted of cast steel plates, 12″ square which, when the faces were in contact, formed a chamber of predetermined width in which the filter cloths hung. This press was operated by hand-driven screws and compressed air, the pressure reaching 140 pounds per square inch.

Such good results were secured from these two types of presses, which had been furnished and operated at the expense of the manufacturers, that the Sewerage Commission purchased a larger press of each type and installed them so that they could be operated continuously and under like conditions as would prevail in the ultimate plant.

Different types of racks were used on the Berrigan press, and the types of bagging or cloths used ranged from perforated copper to coarse burlap. Different types of plates were used in the Simplex press, consisting of the Simplex, Johnson, Worcester and Sperry. The press was operated with a central feed and also with a top corner feed.

In order to separate the water from the sludge during pressing, certain agents were used consisting of sulphurous and sulphuric acid, copper sulphate, alum, coke-plant waste and filter cell, each of which was varied from time to time.

Under Mr. John Arthur Wilson, Consultant Chemist, the influence of the acidity and alkalinity upon the dewatering process was thoroly investigated and the proper pH values to secure the best dewatering results, were determined.

In the fall of 1920, a Besco-ter-Meer centrifuge was installed by the Barth Engineering and Sanitation Company and was operated almost daily until July, 1921. In 1922, another centrifuge of the same type, but operating at a higher speed, was installed by the same company and is still being investigated.

In 1916, a vacuum filter of the Kelly type was purchased and operated for some weeks without giving any promising results. Early in 1921, a vacuum filter was built of the tank type, which gave such promising results that, late in the fall, the Oliver Filter Company of San Francisco was invited to erect at the plant a small vacuum filter for demonstration purposes, which invitation was accepted. This filter has been and is being operated under a great many different conditions since its installation.

In addition to the above described dewatering devices, the open laundry type of centrifuge, the Sharples separator and the high-pressure Johnson type of filter press were installed and tried out. A small dryer of the Buckeye direct-indirect type was purchased, erected and operated for several months. While operating this dryer, the question of washing the gases, so as to eliminate objectionable odor, was studied and satisfactorily solved. Tests were also made upon drying the sludge in a Smith indirect dryer, and in a direct dryer of the American Process type.

The foregoing gives, briefly, the several apparatus which have been used at Milwaukee in dewatering the sludge produced by the activated sludge process and conveys some idea of the magnitude and thoroness of the investigation. It does not, however, convey any idea to the uninitiated of the many hopes and disappointments experienced by those in charge of this work or the sleepless nights they spent.

The first dewatering apparatus tried was a vacuum filter of the Kelly type. This was purchased and tried in 1915 without securing any results. The last apparatus tried was a vacuum filter of the Oliver type which has given the best results of all other apparatus tried.

It has already been stated that both the plate and platen presses gave such promising results upon a small scale that working-sized presses of these types were purchased and operated over long periods. After runs, extending from November, 1919, to December, 1920, with these presses, the conclusion was reached that either type of press could do the work at a reasonable cost and plans were practically perfected to ask for bids for both types. During the winters of 1920 and 1921, and 1921 and 1922, the sludge was in such a changed condition that neither of these presses could dewater it as they had done the previous seasons, and the plans made for their installation were scrapped.

When the Besco-ter-Meer centrifuge was first put into operation, its results were extremely promising but, as the conditions of the sludge changed and the machine speeded up to get a production which would warrant its use, it had to be abandoned as not being adaptable to Milwaukee conditions.

The few experiments conducted with the laundry type of centrifuge and the Sharples separator indicated conclusively that

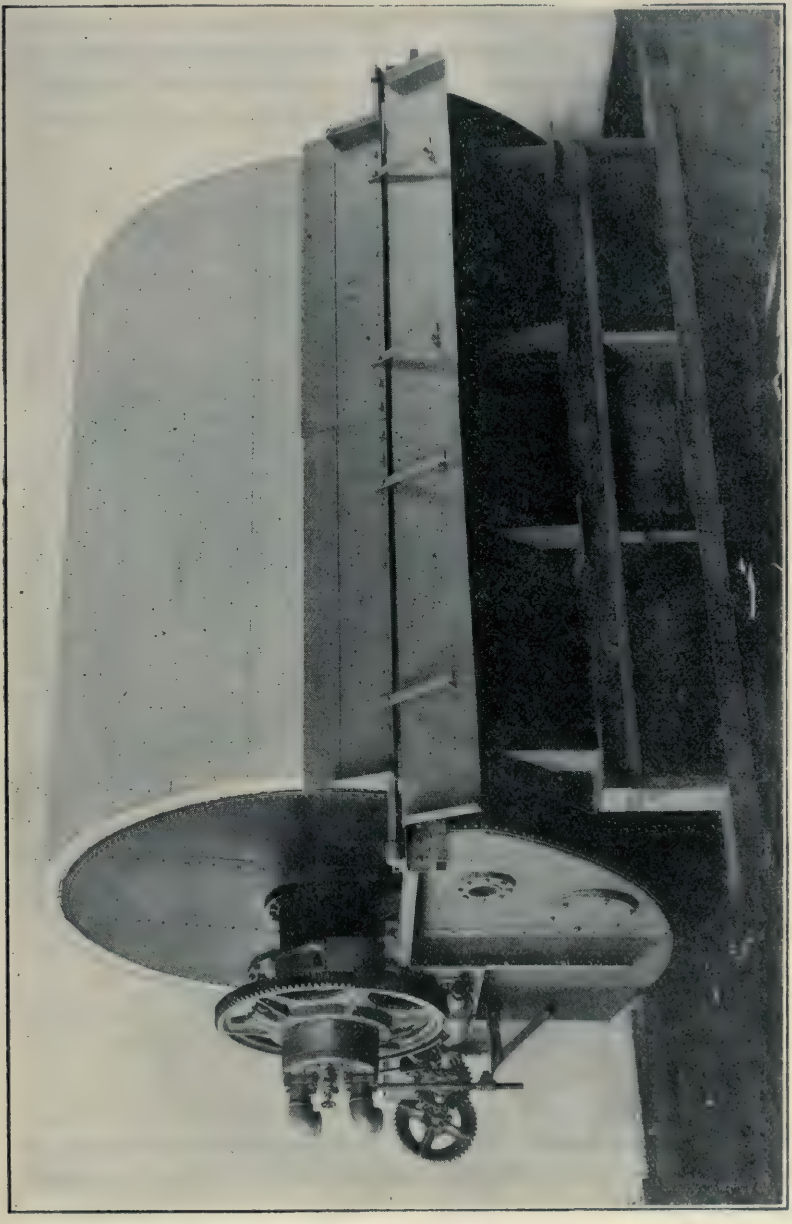
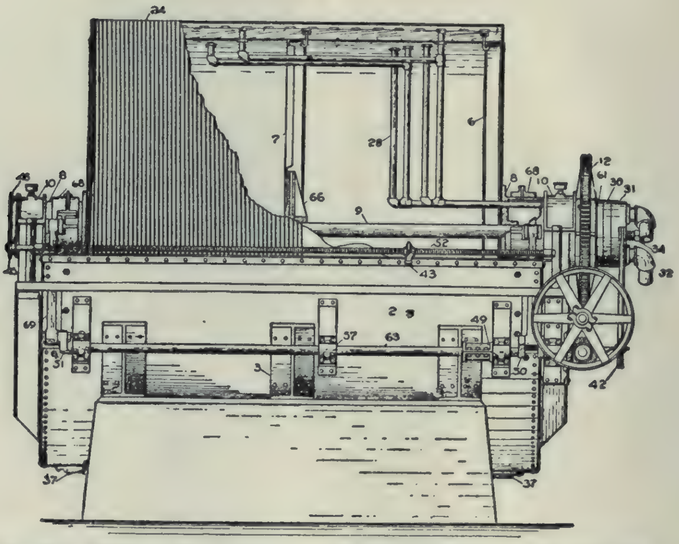


Fig. 1. Oliver Vacuum Type of Filter

neither machine would accomplish, within reasonable cost, the work to be done. The Johnson high pressure press could dewater the sludge to the lowest moisture content of all the other apparatus tried but, from the records obtained, the cost was prohibitive.

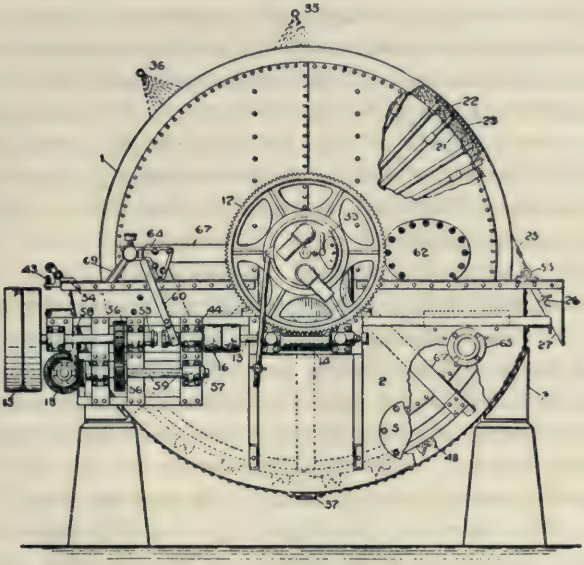


FILTER WITH OSCILLATING AGITATOR AND ENCLOSED HEADS

List of Parts

1. Filter Drum
2. Steel Filter Tank
3. Tank Supports
5. Tank Manhole
6. Channel Steel Drum Rims
7. Channel Steel Drum Arms
8. Hollow Cast Iron Trunnion
9. Steel Drum Shaft
10. Main Bearings
12. Worm Drive Gear
13. Worm Shaft
14. Oilwell for Worm
15. Drive Pulleys
16. Wiring Pulleys
18. Bevel Gears
21. Wood Staves for Drum
22. Division Strips
23. Filter Medium
24. Wire Winding
25. Steel Scraper
26. Scraper Adjuster
27. Apron
28. Vacuum and Air Pipes
30. Removable Valve Seat
31. Automatic Valve
32. Vacuum Connections
33. Air Connection
34. Valve Stem

During the late fall of 1921, the Oliver Filter Co. of San Francisco, installed, at its own expense, in the testing station, one of its vacuum type filters, 3′1″ in diameter and 2′2″ long, containing about 18 square feet of effective filtering surface. The accompanying plates will illustrate this type of filter. The circumference of the filter is made up of an air-tight division, outside of which, and about one inch therefrom, is a bronze screen of coarse mesh over which is stretched a canvas cloth which is attached to the drum by means of steel wire wound around the canvas about one inch apart, which holds the canvas in position.



FILTER WITH OSCILLATING AGITATOR AND ENCLOSED HEADS

List of Parts

35. Wash Water Sprays
36. Wash Solution Sprays
37. Drain Flange
42. Valve Adjuster
43. Wire Spacing Nut
44. Worm Shaft Bearings
45. Wiring Sprockets
48. Oscillator Rakes
49. Shaft Coupling
50. Agitator Crank
51. Agitator Crank
52. Wiring Feed Screw
53. Jaw Clutch
54. Wiring Screw Bearings
55. Scraper Bearings
56. Spur Gear
57. Oscillator Shaft Bearings
58. Pulley Shaft
59. Intermediate Shaft
60. Clutch Shifter
61. Valve Pipe Plate
62. Drum Manhole
63. Oscillator Shaft
64. Connecting Rod Bracket
65. Overflow Weir
66. Center Spider
69. Connecting Rod

The outer circumference is divided into segments to which the vacuum and air pipes are connected. These pipes are also connected thro the drum shaft with the port box built upon this end of the shaft. As the drum slowly revolves in the sludge, at a rate of less than a foot per minute peripheral speed, an eleven-inch vacuum is maintained upon the portion of the filter surface submerged. This draws the sludge to the filter surface. As the circumferential surface leaves the sludge, twenty-two inches of vacuum are held which draw much of the water from the sludge. Just before the filter surface is again submerged, the air or steam port is opened and this air or steam loosens the sludge from the surface, permitting the scraper to completely detach it. The machine is continuous and needs little attention when its speed has been predetermined. It produces an effluent low in turbidity and suspended matter which can with safety be discharged either into the aerating tanks of the activated sludge process or into the effluent therefrom, and a sludge containing from 78 to 82 percent moisture from one containing from 98 to 99 percent moisture, or a reduction of about 75 percent.

In order to better comprehend the problem of sludge dewatering at Milwaukee, it may be well to digress a moment to explain, in brief, the great difference between the sludge produced by the activated sludge process during the winter and summer months. Omitting technical terms and explanations, which would only tend to becloud the question to many minds, the fact is that during the winter months, when the temperature of the raw sewage reaching the plant is from 65° to 45° F., it requires from 30 to 100 minutes to filter the water from the sludge thru filter paper, whereas during the summer months, when the temperatures are above 65°F., from 3 to 10 minutes are required. This means that, unless the winter sludge is treated in some manner to assist dewatering, the cost of installing and operating any type of apparatus for winter conditions would be prohibitive.

Temperature is, perhaps, the most influential agent encountered in the dewatering of activated sludge, and many experiments have been made to ascertain how to meet it. The sludge, before going to the presses, was maintained at a temperature of 70°F. for weeks at a time, but gave very little improvement in time of dewatering by means of the presses. When the entire sewage flow was maintained at a 70°F. temperature, real summer conditions were obtained and the time of dewatering corresponded to summer conditions. Maintaining the entire sewage flow at such a temperature by artificial means is, of course, prohibitive in cost.

As previously stated, during the year from November, 1919, to December, 1921, great numbers of pressings were made with the Berrigan, Simplex and Johnson type of presses, with the result that the Berrigan type of press produced from 0.0015 to 0.003 pound of sludge per minute per square foot of filter cloth —sludge based upon 10 percent moisture, although the moisture content in the press cake was about 80 percent. This means that if each press contained 18 bags having an aggregate of 1300 square feet of filtering surface, the number of presses required for summer conditions would be 48 whereas the winter conditions would require 84.

The Simplex press with Johnson plates produced 0.0015 to 0.007 pound per minute per square foot of filtering surface, on dry basis, and required from 23 presses for summer to 102 presses for winter, each press having 60 cells 40″ x 40″. The great difficulty, however, with the Simplex-Johnson type was to secure clean bags after each operation during winter conditions. Without clean bags, the operation became difficult and expensive.

In order to facilitate the pressing of sludge, sulphuric and sulphurous acid and alum were used in various quantities. The former was used at an average rate of 4.5 cc. per gallon of sludge. Filter cell was used to great advantage except as to cost, which was prohibitive.

During 1920 and 1921, the Besco-ter-Meer centrifuge was tried under all conditions which were suggested. This machine was built to operate at 900 r.p.m. but was usually operated, after the first few months, at from 1200 to 1350 r.p.m. The average yield for either winter or summer sludge was 1.44 pounds of sludge per minute (10 percent moisture basis), the sludge cake containing from 80 to 83 percent moisture. Sulphuric acid added to the sludge before centrifuging did not increase the yield or decrease the moisture. The average removal of dry solids by means of the centrifuge was about 25 percent, and here was the weakness of the centrifuge to meet Milwaukee requirements.

It was hoped that the effluent from the centrifuge might be run into aerating tanks in which much of the solids might be digested before they again reached the centrifuge. It was found, however, that these solids pyramided in the tanks until their volume became greater than the tanks would carry.

Another centrifuge of practically the same type but built to run at a speed of 1800 r.p.m. was installed. This gave far better results, removing as much as 75 percent of the solids but the remaining 25 percent were so fine as to be thrown back into colloidal form from which it was difficult and expensive to remove the water. This could be done, however, by settling for 10 to 12 hours after adding alum or other precipitant, but the cost was prohibitive.

As previously stated, the last and most promising apparatus so far used for reducing the moisture in the sludge to 80 percent is the vacuum filter of the Oliver type. With raw winter sludge, no results worth while could be secured even tho the proper amount of sulphuric acid was added to maintain the optimum pH value. It was necessary to heat the sludge to a temperature from 120 to 180°F. to get results. Excellent production could be obtained with summer sludge without heating altho the cake moisture was seldom below 83 percent.

The acid flotation process was tried to condition the sludge preliminary to filtering. This proved unsatisfactory because the effluent produced from the flotation tanks was too turbid and carried too many suspended solids to permit of its discharge into the raw sewage without pyramiding the aerating tanks.

From the results of the operation of the vacuum filter, it appears that the best results can be obtained by first adding sufficient sulphuric acid to the raw sludge to maintain an optimum pH value ranging from 2.5 to 4.2, then heating it to a temperature ranging from 140 to 180°F. The higher the temperature up to 190°F. the greater the yield. Above 190°F., the production rapidly decreases. With a temperature of 160°F. and using about 4.5 cc. of sulphuric acid per gallon of sludge, the filter will produce about 0.01 pound of cake (10 percent basis) per minute per square foot of filtering surface—which is to say, a 500 square foot machine (about 12′ dia. by 14′ long) will produce, per day, from 99 percent moisture sludge, 144,000 pounds of 80 percent moisture cake equivalent to 7200 pounds of dry material containing 10 percent moisture; and from 98 percent moisture sludge, it will produce 72,000 pounds of 80 percent moisture cake equivalent to 7200 pounds of dry material containing 10 per cent moisture.

As previously stated, under winter conditions the activated sludge process will produce approximately 23,500 gallons of 99 percent moisture sludge, and in summer, from 12,000 to 15,000 gallons of 98 percent moisture sludge is produced per million gallons of sewage treated. That is, the city of Milwaukee would have to provide 39 vacuum filters each of 500 sq. ft. surface to provide for treating the sludge from 85 m.g. of sewage per day, which is the expected volume in 1930. This is estimated upon the basis of a 22-hour day.

If the heat necessary to raise the temperature of the sludge from 50 to 160°F. had to be obtained directly from the burning of fuel and without doing other useful work, the cost of heat-conditioning the sludge would prove costly, but in the case of Milwaukee, if the vacuum type of filter is adopted, the heat required will be obtained from the exhaust-steam from a 1000-k.v.a. non-condensing steam-turbo-generator which will supply the power for operating the many small motors and lights about the disposal plant, and also from the exhaust steam produced from the vacuum pumps necessary for operating the filters, thus reducing the cost of heating to the cost of the difference between running the turbo-generator and vacuum pumps condensing and noncondensing.

Reducing the moisture in the sludge from 80 to 10 percent is not much of a problem requiring, as it does, the same type of apparatus used in a great many industries for reducing the moisture in solids. There are many types of dryers which will do the work, some more economically than others it is true. It is a question of bringing the heat into the most intimate contact with the moisture-laden cake. This can best be done when the cake is separated into small particles and the heat is as dry as possible. Too high temperatures will burn the cake and destroy much of the nitrogen. High temperatures coming into direct contact with the moist cake tend to ball it, making a crisp covering over a wet interior. This condition requires the balls to be returned to the dryer where they are broken up into smaller particles from which the interior moisture is driven out.

Dryers of the direct or direct-indirect type are capable of removing about 10 pounds of water per pound of combustible, or per 0.66 pound of coal containing approximately 12,000 B.t.u. per pound. A direct-indirect dryer, about 60 ft. long and 78 inches in diameter, if properly designed, can remove about 6000 pounds of water per hour. The dryer should be so designed that the maximum temperature of the heat in contact with the cake should be under 700°F.

Before closing these remarks upon the apparatus for dewatering the sludge, attention should be called to the so-called McLaughlin process as used in Gastonia, N. C., and now being tried out upon a larger scale at Houston, Texas. This apparatus consists of a pulp-recovery machine, as commonly used in paper making, and a fine screen. The screen revolves in a sludge highly charged with sulphur-dioxide gas, the solids being caught upon the surface of the screen. A felt belt, coming into contact with the surface of the screen, picks up the solids, carries them thru heavy rolls which press out much of the moisture, and delivers the solids at about 80 percent moisture. The belt is kept clean by an abundance of water sprayed upon it during its return journey to the screen.

From the records so far available, this apparatus is doing very promising work. Its yield is quite large and the cake in good condition for drying. The effluent is rather high in suspended solids as it contains the smaller particles passing the screen and those washed from the returning belt.

Before closing this paper, it might be interesting to inform the Society what has been accomplished in determining the growing value of the activated sludge as a fertilizer.

At the convention held in Baltimore last year, your Sewerage Committee was requested to cooperate, so far as possible, with the United States Agricultural Department in investigating this subject, and to this end the writer attended a conference in Washington with members of the Bureau of Plant Industry and of Soils and with the United States Public Health Service, all of whom promised hearty cooperation within the limits of their time and funds.

A program was laid out and Dr. Schreiner of the Bureau of Soils was intrusted with having it carried out. He visited the Agricultural Department of the University of Wisconsin, in company with the writer, and the Agricultural School of Milwaukee County, with the result that growing tests were begun and have since been carried out at two of the experimental farms under the direction of the University and at the Agricultural School.

The tests were made in strict comparison with the common types of fertilizers used and upon such crops as beans, corn, oats, beets, etc. During the growing season, the writer inspected the growths and found that the activated sludge compared most favorably with the other types of fertilizers used. The actual records have not been submitted as the harvest has just been completed. It may be said, however, that so far the indications point to the conclusion that activated sludge can be converted into a valuable fertilizer without fear of inoculating the soil with undesirable bacteria, and gives great promise of being successfully marketed.

Discussion of this paper will be found on page 123.

THE CENTRIFUGING OF SEWAGE SLUDGE

By H. Burdett Cleveland, Consulting Engineer, Barth Engineering and Sanitation Co., Albany, N. Y.

For several years there has been a decided tendency on the part of sanitary engineers to question the economy and desirability of dewatering sewage sludge on sludge drying beds. It has been realized that some effective mechanical method of dewatering would be cheaper and more sanitary; that it would be less productive of conditions of nuisance, and would eliminate the uncertainties due to freezing weather and rainfall.

Mechanical methods have been extensively used in England where filter presses are employed, and in Germany where both filter presses and centrifuges are used, but in this country sludge disposal by mechanical means has not been carried on for any considerable period except at two places, Worcester and Providence, where filter presses have been operated for over 25 years.

However, it is not within the province of this paper to review in detail the advantages of mechanical means for dewatering sludge, nor to compare at length the good and bad features of the several forms of apparatus which have been used or experimented with in an effort to solve this problem.

This limitation brings us to a specific discussion of the centrifuge, and directly to a description of the Besco-ter Meer centrifuge, since this is the only centrifugal machine yet devised which can be successfully used to dewater sewage sludge from the standpoint of efficiency as well as economy.

The Besco-ter-Meer centrifuge is being developed and introduced in this country by the Barth Engineering & Sanitation Company. It is because it is the settled policy of this company to carry on its work in sewage disposal on purely technical lines, and not on the improper commercial basis which has characterized various endeavors along similar lines, that the writer has been asked to prepare this paper, and has been glad to respond.

Many engineers have felt for several years that the centrifuging of sewage sludge eventually would be found to be the best, cheapest, and most effective method of dewatering. This viewpoint has been confirmed at a number of places in Germany, where the Ter-Meer centrifuge has been in successful operation since 1914.

The outstanding feature which has brought this machine into prominence is its great output. It is the first imperforate wall centrifuge manufactured from which dewatered material can be discharged without either stopping or retarding the revolutions of the drum, and without interrupting the feeding of sludge to the drum except during the 20 to 30-second interval required to discharge the cake.

This feature results in an hourly output which is 6 to 8 times greater on any material than would be possible were it necessary to stop the drum after each run for the purpose of removing the dewatered material.

The centrifuge, including the outer housing, weighs about ten tons. The centrifuge drum, consisting of a solid wall bowl, is 36 inches in diameter. The height of the drum at the outside or cake-discharging face is 10 inches, and the depth of the drum at the inner face of the cake pocket, which is also the effluent overflow zone, is 18 inches.

The thickness of the cake may be varied from ½ inch to 6 inches, depending on the material which is being dewatered, and the dryness of the cake desired. The dried cake, weighing from 150 to 200 pounds, discharged at the end of each run of 5 to 20 minutes, is broken up as it strikes against the outer housing.

The drum is revolved at 1300 to 1800 r.p.m. by a 25 to 30-h.p. slip-ring motor. A 10-h.p. motor supplies oil pressure by means of which the bearings are lubricated and the centrifuge is kept under continuous and entirely automatic operation. The small motor also operates the automatic control apparatus and the mechanical feed valve.

In the operation of the centrifuge wet sludge is fed into the drum at the bottom while the drum is under full revolution, and the inletting of sludge is continued for a predetermined period of time, depending on the moisture content of the sludge and the rate of inlet employed. With the passage of the sludge up through the drum, the suspended solids are thrown by the centrifugal force developed toward the outer wall of the drum, and the effluent passes out of the drum over the central overflow ring.

At the expiration of each period of inletting, the inflow of sludge is automatically stopped. The outer wall of the drum then drops automatically, which allows the dried cake to be discharged by centrifugal force outwardly from the drum and against the outer housing, since the drum revolution continues at full speed. The drum wall then rises to the closed position and the inlet valve automatically opens; about one-half minute having elapsed since the inlet valve was closed to permit the discharge of dried cake.

No manual labor is required in the operation of the centrifuge. One machinist's helper can look after 5 to 10 machines, his principal duty being to fill oil and grease cups on the auxiliary apparatus, and to set the automatic control apparatus, after the first run from a holding tank, so that the inlet rate and the run cycle correspond to the moisture content of the sludge. The power consumption necessary to operate the machine, including the auxiliary apparatus, amounts to 16 kw. per hour.

The wet sludge is fed from a mixing tank or from a manifold down thru a fixed pipe reaching to a point near the bottom of the drum and near the main shaft. The rate of inlet varies for different sewage sludges from 1000 to 3000 gallons per hour, depending on the character and condition of the sludge, and the percentage of removal of suspended solids desired. The dried cake, after being discharged from the drum into a circular cake channel, is either carried by a slow-moving scraper to a chute for side discharge, or is dropped into a channel passing under several machines in series and then conveyed by belt or screw conveyor to a bin or to a drier.

It will be seen that no handling of sludge or of cake, nor of containers for sludge or for cake, is involved in the operation, since the wet sludge is piped to the centrifuge drum and the dried cake is removed by mechanical means as soon as produced. This feature is very important, since it not only eliminates all manual labor costs, but it minimizes conditions of nuisance from sludge handling and does away with the problems of sanitation and with the disagreeable operations incident to all other processes.

In addition to the great saving in labor cost a very material economy is effected by the centrifuge by reason of the fact that no preliminary treatment of the sludge is required, under either winter or summer conditions, such as acidifying or heating or both, an expense necessary with all other mechanical processes of dewatering.

Such preliminary treatment in other mechanical processes may cost from 3 to 8 times the power cost, depending on the process employed, whereas the power cost to operate the centrifuge is about the same as for other types of apparatus.

The greatest difficulty which it has been necessary to overcome in adapting the centrifuge to meet our requirements in this country has been to secure a high degree of removal of suspended solids without so decreasing the rate of inlet, and consequently the hourly capacity of the machine, as to render its use uneconomical.

This problem has been much more difficult in connection with activated sludge, as referred to by Mr. Hatton and as shown by the earlier experiments at Milwaukee, than in connection with settling-tank sludge.

The specific gravity of activated sludge is only 1.01 to 1.015, while settling-tank sludge has an average specific gravity of 1.025. Centrifuges operating in Germany on materials of but very little greater specific gravity than sewage sludge are being successfully operated at 750 to 900 r.p.m.

At Baltimore it was found that settling-tank sludge could be effectively dewatered without too great a fouling of the effluent at rates of inlet which would show an economy over the operation of sludge drying beds.

The duty of the centrifuge at sewage-disposal plants in Germany ranges from an inlet rate of 15 gallons to an inlet rate of 40 gallons per minute when dewatering settling-tank sludge of from 90 to 95 percent moisture. The cake moistures are usually from 65 to 70 percent, and the removal of suspended solids ranges from 65 to 75 percent.

Thru the cooperation of Mr. Hatton and the Milwaukee Sewerage Commission we have had an excellent opportunity to test the machine on activated sludge, and to work out improvements to increase its efficiency.

In the tests beginning in October, 1920, it was found that activated sludge could be reduced from 98 percent moisture to a cake having 80 to 83 percent moisture, but at the comparatively low inlet rate of 10 gallons per minute, and with a removal of 40 percent of the suspended solids.

In April, 1921, the writer devised an inner feeding bell which brought the removal percentage up to 70 percent, but which still did not permit an increase in inlet rates such as has been obtained since that time.

A further improvement was tried out last winter in Baltimore in a series of experiments made possible thru the cooperation of Mr. Ruark. This improvement consists of the incorporation in the drum of a drainage ring which provides means for filtering the liquor containing the finely divided solids, after the sludge is first freed of the coarser solids by the centrifugal action in the drum. These two processes are carried on simultaneously in the drum.

By the use of this drainage ring in its initial form we were able to produce at Baltimore 200 pounds of 70 percent moisture cake in less than 6 minutes from 92 percent moisture semi-digested sludge, the inlet rate being 21 gallons per minute, and the proportion of suspended solids removed averaging 69.5 percent.

This development work has been continued at Milwaukee, and may be said to have passed the experimental stage during the past month.

We are now able, with a drainage ring devised by the writer in June of this year, to produce an effluent showing 90 to 95 percent removal of suspended solids from activated sludge having 97 to 99 percent moisture content. We expect to be in a position, shortly, to accomplish these results at an inlet rate of 25 to 35 gallons per minute, with a resulting cake moisture of 83 to 85 percent. The improvement in results accomplished by the centrifuge is referred to in detail to show that we intend to make the machine entirely applicable to sewage sludge dewatering, with the hope that it will fill an existing need.

A further demonstration of the centrifuge at Baltimore has been arranged for, and two centrifuges have been included in the plans for enlargement of the Canton, Ohio, plant where there will later be an opportunity for demonstrating the capacity of the machine in dewatering Imhoff-tank sludge. Additional data will be available when the centrifuge purchased by the Sanitary District of Chicago is operated on activated and Imhoff-tank sludges at the Des Plaines River and Calumet plants of the Sanitary District.

Discussion of this paper will be found on page 126.

THE FERTILIZER VALUE OF ACTIVATED SLUDGE

By Irving P. Kane, Assistant Engineer, The Sanitary District of Chicago

During the fall and winter of 1920, the writer investigated the probable commercial value of activated sludge, particularly as applied to sludge produced on a large scale in the Sanitary District of Chicago. These data are briefly summarized herein.

In studying the commercial practicability of recovering the fertilizer value in the sludge produced by the activated sludge process, many difficulties arise. There is little experience to rely upon, as the process is in its infancy and the sludge has never been marketed on any scale.

To understand the factors affecting the probable value of activated sludge as a fertilizer ingredient, a brief sketch of the general fundamentals of the manufacture of fertilizer is helpful. The plant foods supplied by fertilizer are nitrogen, phosphoric acid, and potash, either singly or in various proportions. Nitrogen is the most expensive, and is used in three forms, nitrate, ammonia, and organic nitrogen.

The nitrogen is derived principally from the following sources:

I. Mineral, inorganic:
    - Nitrate of soda from Chile.
    - Nitrate and ammonia from the air.
    - Sulphate of ammonia from coke, gas and bone black manufacture.

II. Animal, organic:
    - Dried blood.
    - Tankage.
    - Dried fish scrap.
    - Guano.
    - Garbage.
    - Peat.

III. Vegetable, organic:
    - Cotton seed meal.
    - Castor pomace, castor bean with oil extracted.
    - Linseed meal.
    - Soy bean meal.
    - Rape meal.

IV. Cyanamid, from the air.

V. Base goods:
Nitrogen from hair waste, wool waste, leather products, garbage, peat, and other nitrogen-bearing materials which have been mixed with phosphate rock and sulphuric acid in the mixer and allowed to cure in a close bin.

The phosphoric acid is derived from:

I. Phosphate rock treated with acid to make acid phosphate or double acid phosphate.
II. Bone products.

The potash is derived from:

I. Potash salts.
II. Miscellaneous materials as natural brines and marls and kainit.

The commercial fertilizers as commonly used usually have either all three of these plant foods in them or have phosphoric acid and potash only.

The production of dried fish scrap in this country increased from about 6000 tons during 1908 to about 24,000 tons during 1914.

The production of crude, air-dried peat for fertilizer purposes increased during the same period from 23,000 tons to 38,000 tons. The average pre-war value was about $5.00 per ton. The plants producing peat are located near the fertilizer factories and are scattered thru 13 fertilizer-consuming States.

The annual production of sulphate of ammonia increased from 83,000 tons during 1908 to 423,000 tons during 1919. Of this total there were produced 375,000 tons from the by-product of coke ovens. Coal-gas and bone-carbonizing works, etc., produced 48,000 tons.

During 1908 there were imported 311,000 tons of nitrate of soda. These imports during 1918 amounted to 407,000 tons.

The production of cotton-seed meal and cake showed a gradual increase before the war from 845,000 tons during 1900 valued at $19.00 per ton to about 2,000,000 tons during 1913 valued at $25.00 per ton. A considerable quantity of cotton-seed meal as well as dried blood and tankage are used for feeding purposes. The quantity of these materials used for cattle food will depend upon the relative value of organic ammonia for fertilizer purposes and the value of cattle food, as well as the cost of transportation to the various markets. The greater the demand for cotton the larger will be the supply of cotton-seed meal.

The following table shows the relative amounts of cotton seed meal used for fertilizer and feeding purposes.

YEAR	FERTILIZER	COTTON SEED MEAL IN TONS		
	Tons	Total	Feeding	Fertilizer
1905	3,600,000			185,000
1913	6,560,000	1,700,000	1,200,000	500,000
1918	6,780,000	2,000,000	1,300,000	700,000
1919	6,930,000	1,600,000	850,000	750,000

The relative amounts of organic and inorganic nitrogen used for fertilizer purposes are shown herein:

YEAR	FERTILIZER	NITROGEN IN FERTILIZER TONS			
	Tons	Total	Organic	Inorganic	Per cent organic
1905	3,600,000	56,000	46,000	10,000	82.0
1914	7,370,000	168,000	80,000	88,000	47.5
1919	6,930,000	154,000	62,000	92,000	40.0

In the manufacture of fertilizer the various materials are first thoroly analyzed and the mechanical condition tested. Then they are mixed to conform to the formulae desired. The different fertilizers require the nitrogen in different forms as part nitrate, part ammonia and part organic to be mixed with the acid phosphate or potash salts. These must be very carefully mixed, as the State laws are very strict. Heavy fines are imposed in case the percentages of the various plant foods fall below the formula stamped on the bag. For this reason materials which do not vary in chemical analysis, as cotton-seed meal and nitrate of soda, are preferred to those which may show a variation in their nitrogen analysis.

The principal standard formulae follow, as adopted by the National Fertilizer Association (1919) showing percentage of plant food.

	Ammonia	*Phosphoric Acid*	*Potash*
	2	10	4
	2	10	6
	2	12	2
	0	12	2
	0	12	4
	3	10	2
	3	10	4
	3	10	6
	3	8	3
	4	10	4
	4	10	6
	5	8	7
	7	8	3
	7	8	6
Cotton formula when boll weevil present (Halligan)................................	3	8	5
The most extensively used for cotton (Halligan)................................ where the nitrogen is derived partly from nitrate of soda and cotton seed meal or tankage.	3	8	2
Tobacco—Florida, Virginia and Kentucky (Halligan)................................	3	9	10
	4	9	10

The principal sources of organic nitrogen used in commercial fertilizer are:

Dried blood........	12 to 13% ammonia	1 to 3% phosphoric acid
Tankage............	8 to 11% ammonia	7 to 9% phosphoric acid
Cotton-seed meal.........	8% ammonia	2.8% phosphoric acid and 1.5% potash
Dried ground fish....	8 to 11% ammonia	10 to 14% phosphoric acid

In the manufacture of commercial fertilizer, the higher grades of raw materials are used in medium and high grade fertilizer. The following examples indicate the calculation.

Raw materials required to manufacture 2000 pounds of fertilizer using 4–10–6 formula:

Lb.	*Raw Material*	*Lb.*	*Plant Food*
900	High grade tankage	80	Nitrogen
860	High grade super-phosphate	63	Phosphoric acid
240	Murate of potash	137	Phosphoric acid
		120	Potash
2,000	Fertilizer containing	400	Plant food

2–10–4 formula using sludge and nitrate of soda to supply the nitrogen—

Lb.	*Raw Material*	*Lb.*	*Plant Food*
520	Activated sludge	21	Nitrogen
120	Nitrate of soda	5	Phosphoric acid
1,200	High grade super-phosphate	19	Nitrogen
160	Murate of potash	195	Phosphoric acid
		80	Potash
——		——	
2,000	Fertilizer	320	Plant food

This indicates that activated sludge containing 4.5 percent ammonia can only be used in the low grades of complete commercial fertilizer, using the high grade super-phosphate which is ordinarily commercially used. There is a higher grade of double-acid phosphate now produced on a small scale but at a high price. In other words, in a mixed fertilizer, the phosphoric acid is obtained from a material containing a low percentage of phosphoric acid (P_2O_5) and when this is mixed with a material with a low nitrogen content, this limits the formulae or mixtures in which the constituents can be used. This in turn may limit the use of activated sludge.

The locations of the fertilizer factories in the United States in 1919 as given by the American Fertilizer handbook 1921 are as follows:

States	*Number.*	*States*	*Number.*
Alabama	40	Massachusetts	2
Arkansas	2	Michigan	1
California	16	Minnesota	1
Connecticut	6	Mississippi	9
Delaware	7	Missouri	2
Florida	24	Nebraska	2
Georgia	144	New Jersey	19
Illinois	12	New York	6
Indiana	16	North Carolina	45
Iowa	1	Ohio	21
Kansas	4	Pennsylvania	31
Kentucky	4	South Carolina	50
Louisiana	6	Tennessee	10
Maine	10	Texas	9
Maryland	45	Virginia	44

This totals a little over 590 plants but does not include a few plants in scattered states.

The capacity of these plants ranges from a few hundred tons to about 100,000 tons annually. The plants are centrally located with reference to raw materials and the market, as it is not economical to ship the finished fertilizer nor many of the raw materials long distances, especially the low-grade materials as phosphate rock, peat and garbage. The cotton-seed meal and dried fish are produced locally. Tankage comes from the producing centers. Nitrate of soda, potash, and guano come by water. Sulphate of ammonia is high grade and is shipped from the coke-producing centers. The Mussel Shoals plants may in the future furnish large quantities of nitrogen. Sludge produced in large quantities in a center like Chicago would be under a handicap, as the freight charges in proportion to plant-food content will be about 2.5 times as much as for high grade tankage, and many times those materials which are produced locally. The manufacture of fertilizer in the United States has ranged as follows:

1912	*1913*	*1914*	*1915*	*1916*	*1917*	*1918*	*1919*
6,000,000	6,560,000	7,370,000	5,600,000	5,400,000	6,220,000	6,780,000	6,900,000

The production by States is shown in table 1. The use of fertilizers in the States of Illinois, Wisconsin, Indiana, Iowa, Missouri, Minnesota, Michigan, Kansas and Nebraska has varied from 5.2 percent of the whole in 1911 to 6.47 in 1917 or about 450,000 tons. There is as yet little demand in the west or middle west for high-grade nitrogeneous fertilizers. The principal demand is for phosphoric acid and potash. This may be due to the farming practice of feeding cattle and using the manure. The majority of the packers' fertilizer plants are in the south. The American Agriculture Chemical Company and the Virginia-Carolina Chemical Company, the two largest fertilizer companies of the country have practically all of their plants in the south and east.

There appears to be a pronounced tendency away from low-grade fertilizers. It is impossible, therefore, to forecast how long the demand for low-grade fertilizers will continue. This is due largely to the expense of transporting and handling large quantities of filler or make-weight in order to secure a small amount of plant food. The fertilizers of the future will probably contain much smaller amounts of this material.

There is at present in Europe as well as in America a great excess of capacity to produce nitrogen over the demand. Due to the war demand for nitrogen, the coke ovens and gas plants were fitted with apparatus to recover sulphate of ammonia as a by-product in large quantities. Large plants were built for the recovery of nitrogen from the air, notably at Niagara Falls and Mussel Shoals.

Fertilizer Tonnage by States

Following is the list of States, showing the consumption of fertilizers for the fiscal years ending in 1913, 1914, 1915, 1916, 1917, 1918, 1919 and 1920, compiled from the most reliable statistics that are obtainable. In some of the States there are absolutely no accurate figures available. For these States indicated by an *, estimates have been made, based on information obtained from State officials and fertilizer manufacturers.

State	Fiscal year Ending	1913 Tons	1914 Tons	1915 Tons	1916 Tons	1917 Tons	1918 Tons	1919 Tons	1920 Tons
Alabama	Oct. 1	474,730	592,200	302,350	206,000	210,000	289,990	297,903	388,341
*Arizona	June 30	600	650	650	600	500	500	500	500
Arkansas	Sept. 30	52,000	84,850	26,396	65,600	58,500	88,500	64,427	81,875
California	June 30	36,000	39,471	31,540	29,415	43,964	32,036	43,126	58,636
*Colorado	Dec. 31	500	500	600	1,000	1,000	1,000	1,000	1,000
*Connecticut	Dec. 31	62,000	74,000	80,000	73,000	78,000	80,000	65,000	65,000
*Delaware	Dec. 31	50,000	55,000	45,000	45,000	50,000	54,000	30,398	61,537
Florida	Dec. 31	213,728	240,812	208,782	212,250	214,088	197,954	250,613	272,316
Georgia	Dec. 31	1,120,693	1,282,088	872,979	741,347	895,897	923,020	990,919	978,090
*Idaho	July 1	200	500	500	500	500	500	500	500
*Illinois	Apr. 30	30,000	40,000	35,000	42,000	45,000	45,000	45,000	45,000
Indiana	Dec. 31	193,899	219,000	156,152	132,159	156,000	244,340	241,000	230,184
*Iowa	Apr. 30	3,500	4,200	5,100	5,000	5,000	5,000	5,000	5,000
Kansas	Dec. 31	7,380	9,460	10,060	7,940	7,600	8,000	16,937	12,650
*Kentucky	Dec. 31	75,000	83,000	85,000	62,000	93,000	128,000	103,000	90,000
Louisiana	Aug. 31	98,778	90,588	73,420	96,426	98,264	81,025	97,724	95,864
*Maine	Dec. 31	160,000	168,000	150,000	155,000	160,923	155,000	156,000	168,000
Maryland	Dec. 31	169,000	183,350	168,000	154,000	191,900	173,000	174,500	173,000
*Massachusetts	June 30	51,000	54,000	56,000	53,000	64,000	68,000	61,000	61,450
*Michigan	Dec. 31	57,985	60,000	65,000	70,000	91,455	78,000	103,264	112,616
*Minnesota	Dec. 31	3,500	3,800	4,000	4,500	4,500	5,000	5,000	5,000
Mississippi	Oct. 1	128,050	127,400	85,414	75,667	76,717	104,700	110,000	139,000
*Missouri	Dec. 31	60,000	65,000	57,000	41,000	65,000	90,000	91,000	120,332
*Montana	No law	800	900	1,000	1,000	1,000	1,000	1,000	1,000
*Nebraska	No law	500	500	500	500	500	500	500	500
*Nevada	No law	800	950	1,000	1,000	1,000	1,000	1,000	1,000
*N. Hampshire	Apr. 30	18,000	20,000	16,000	18,000	20,000	18,000	14,000	17,000
New Jersey	Oct. 31	156,661	155,414	153,075	129,800	176,483	153,198	149,485	164,820
*New Mexico	No law	200	200	500	500	500	500	1,500	1,500
*New York	Dec. 31	380,000	420,000	400,000	400,000	420,000	430,000	410,000	400,000
N. Carolina	Dec. 1	840,447	872,820	647,188	650,000	849,728	921,962	961,238	1,221,796
*North Dakota	Dec. 31	500	550	600	700	1,000	1,000	1,000	1,000
Ohio	Dec. 31	183,476	203,000	225,000	187,848	165,857	219,328	305,236	300,000
*Oklahoma	June 30	2,000	2,000	2,000	3,000	3,000	3,000	4,000	4,000
*Oregon	Aug. 30	4,500	6,300	6,500	6,500	7,000	6,000	7,500	5,500
Pennsylvania	Dec. 31	340,000	381,900	316,319	268,455	334,309	340,898	340,000	326,864
*Porto Rico	June 30	18,836	18,164	20,000	37,725	45,767	40,811	21,815	20,000
*Rhode Island	Mar. 31	9,000	12,500	11,000	12,000	11,500	10,000	9,000	10,000
S. Carolina	June 30	918,336	1,095,728	670,610	833,624	850,790	1,064,886	1,033,887	1,253,890
*S. Dakota	July 1	700	1,000	1,500	1,500	2,500	2,500	3,000	3,000
Tennessee	May 31	84,060	93,550	77,390	91,128	99,584	113,000	109,366	112,202
Texas	Sept. 1	75,500	77,400	17,500	39,845	40,500	58,000	46,000	56,700
*Utah	Dec. 31	1,000	1,200	1,500	1,000	1,000	1,000	1,000	1,000
*Vermont	June 30	14,500	18,000	13,500	15,000	14,500	16,000	18,000	20,000
Virginia	Dec. 31	412,434	437,808	406,077	369,520	496,217	430,549	421,484	429,024
*Washington	Mar. 31	1,500	2,400	3,000	3,000	4,000	4,010	4,000	4,000
W. Virginia	June 30	31,852	35,475	46,010	40,000	41,000	59,036	63,000	121,052
*Wisconsin	Dec. 31	4,000	4,500	5,000	5,000	6,500	7,500	10,000	12,000
*Wyoming	No law	200	400	500	500	500	500	500	500
Totals		6,544,345	7,340,528	5,563,212	5,390,549	6,206,543	6,756,743	6,891,322	7,654,239
Hawaii	June 30	67,000	80,000	70,000	65,000	80,000	64,000	71,000	70,000

In the fertilizer field there is a tendency towards the use of chemicals and away from organic nitrogen in this country. In 1905 there was manufactured in this country about 3,600,000 tons of fertilizer containing 56,000 tons of nitrogen of which about 46,000 tons were organic. There were manufactured in this country during 1919 about 7,000,000 tons of fertilizer containing about 154,000 tons of nitrogen of which about 62,000 tons were organic. This shows in the 15 years an increase in the use of fertilizers of nearly 100 percent while the amount of inorganic nitrogen increased 900 percent. The organic nitrogen increased about 48 percent of which the major portion was supplied by cotton-seed meal. At the present time about 65 percent of the ammonia in fertilizers is derived from chemicals. There will, however, always be a considerable demand for organic materials as certain crops require the nitrogen in that form.

Activated Sludge

Activated sludge has considerable fertilizing value, probably somewhat in excess of peat or manure and somewhat less than garbage tankage. The money which can be realized on this value will depend upon:

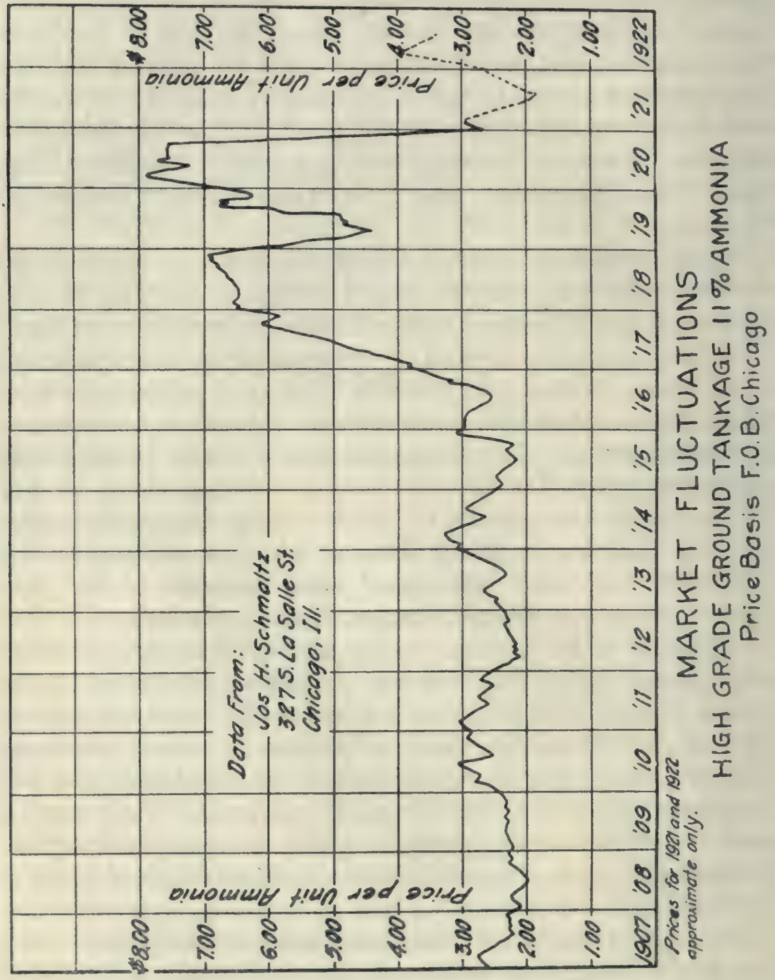
1. Ability to produce a desirable fertilizer ingredient.
2. Cost of nitrogen in the open market.
3. Cost of transportation to the consuming market.
4. Cost of handling, mixing, etc.

To be a desirable fertilizer ingredient a material should be in the proper mechanical condition for use in fertilizer: it should contain sufficient plant food in an available form to make its use economical: its mechanical condition must be such that it will not cake, lump or clog the machinery while it is being planted by the farmer: it must not be subject to spontaneous combustion. It seems probable that sludge will not lump or cake, and that it is not subject to spontaneous combustion. To be a desirable fertilizer ingredient the sludge must have its nitrogen in an available form. The availability must be sufficiently high to satisfy the laws of the several states. The laws of the New England states, New York, New Jersey, Indiana and Michigan prohibit the sale of any fertilizer in which the nitrogen does not show an availability of at least 50 percent by the alkaline permanganate method. Those of North Carolina, South Carolina and Georgia require the availability as determined by the neutral permanganate method to exceed 85 percent. Kansas, Louisiana and Texas prohibit the use or sale of any fertilizer which contains an undue amount of pulverized leather, hair, ground hoofs, horns, wool waste, peat, garbage tankage, or similar products. In the following states, before any fertilizer can be sold containing any of the above mentioned ammoniates, a statement must be made of that fact and proof submitted to the State chemist, that the nitrogen is sufficiently available and valuable for the purpose for which sold: Alabama, Arkansas, Georgia, Massachusetts, Mississippi, Missouri, New Hampshire, New York, Ohio, South Carolina and Tennessee.

The availability of activated sludge has not been widely tested. A few results from various sources showed availability between 35 percent and 50 percent by the alkaline permanganate method. This is an empirical method for determining its availability and is not always correlated with its true value as a fertilizer ingredient. Many States require the source of the nitrogen to be shown on the fertilizer bags. It is not known whether there would be any sentimental prejudice against the use of sewage sludge or not.

The cost of transporting the sludge to the consuming market deserves close study, as the distance which it will pay to ship a fertilizer ingredient will depend upon the value of the plant food it contains. Freight charges decrease the value per unit of ammonia as the distance to the market increases and as the percentage of plant food per ton of material decreases. If the freight expense is $0.60 per unit of ammonia (a unit is 1 percent per ton or 20 pounds per ton) for high grade tankage containing 11 percent ammonia, the expense would be about $1.50 per unit for sludge containing 4.5 percent of ammonia. These studies have been based on the assumption that the sludge will contain 4.5 percent of ammonia and 2 percent of phosphoric acid of which 1 percent will be available.

The cost of handling a fertilizer material in the fertilizer plant per unit of plant food varies with the percentage of plant food in the material—for example: one ton of high-grade tankage has 220 pounds ammonia and 130 pounds available phosphoric acid while one ton of 4.5 percent sludge will have 90 pounds ammonia and 20 pounds of available phosphoric acid. Therefore a fertilizer made up from a sludge and a high-grade acid phosphate would require the handling of 3 tons of material to obtain the equivalent amount of plant food obtained from 1 ton of high-grade tankage. If it be assumed that it costs $2.50 for handling, mixing, bagging, storing and loading one ton of fertilizer, then the sludge



will have a value at the plant of about 55 cents per unit less than high-grade tankage.

The nitrogen in the sludge is organic. To be available for plant food it must be changed to the nitrate form. In the manufacture of fertilizer the nitrogeneous material used will be determined by the use to which the fertilizer is put. For instance, for wheat the nitrogen must be in the nitrate form, because it must act quickly. The organic nitrogen is suitable for long growing crops as it supplies plant food during the whole season. Some crops obtain the nitrogen from the air, as peas, beans, peanuts, alfalfa, clover, etc., and therefore do not require any nitrogeneous material in the fertilizer.

The organic nitrogen is largely used for cotton, tobacco, sugar cane and corn under certain conditions. This limits to a considerable extent the market for the sludge.

There is attached a curve showing the prices of high-grade tankage, f.o.b. Chicago for some years. Inasmuch as much of the material was sold in the south, the price down south was based on the old freight rates.

The commercial value of the ammonia in the sludge seems to be considerably lower than that of high-grade tankage, probably because the ammonia may be less available and also because of the extra cost of shipping and handling. The chief chemist of the fertilizer and food stuffs laboratory of the Louisiana Agriculture Experimental Station estimates its value as about $\frac{2}{3}$ that of high-grade tankage of the same analysis. With high-grade tankage selling at \$2.75 per unit, the value of the ammonia in the sludge would be about $\frac{2}{3}$ of \$2.75 equal \$1.85 − 0.55 for mixing, etc., or about \$1.30 per unit. This is about the relative value placed on garbage tankage. The Bureau of Soils, Department of Agriculture, estimates the selling price of garbage tankage per unit of ammonia as about 50 percent of that of high-grade tankage. The following points need more study:

I. The nitrogen content of the activated sludge.
II. The variation of the nitrogen content of the sludge.
III. The availability of nitrogen in activated sludge by the alkaline permanganate and neutral permanganate method.
IV. The real value of the sludge to growing crops under conditions approximating those under which commercial fertilizers are used.

This study would not be complete without some mention of future prices. While it may be difficult to predict the future of prices with any degree of exactness, they are of such importance in a project of this nature that some attempt should be made, at least, to determine their fundamental trend. General opinion is that freight rates are too high and will be lowered as operating costs come down: but not to prewar levels. The railroads between 1905 and 1914 apparently did not receive sufficient income to operate and maintain properly their plants and pay dividends on their invested captial. It seems as tho in the future they will be allowed sufficient income for this.

The average of commodity prices thruout the world is at present higher than during the past century except for short periods, during and directly after great wars. In America as in Europe, prices have risen rapidly during every great war, only to fall to lower levels after the war than prevailed before. The history of commodity prices shows they follow great cycles, rising for many years and then falling. American prices after a long decline reached a low level in 1897 and then began a long gradual rise of 70 percent until 1914, culminating in a very rapid rise in 1920.

It seems to be almost generally recognized by the leading economists and bankers that interest rates thruout the world will decline for many years to come, and that a fundamental change is occurring in the general trend of prices and during the next 15 to 25 years (disregarding temporary fluctuations) the general trend will be downward. However fertilizer prices took a tremendous drop from 1919–20 to 1921. It is therefore a question whether fertilizer prices will drop materially, as the demand at present seems subnormal. If the nitrogeneous producing industry proves to have too much manufacturing capacity, somewhat lower prices may result.

Summary

The manufacture of commercial fertilizer is increasing in the United States. Much of this increase has been in the use of inorganic nitrogen. The increased use of organic nitrogen has been much smaller and is largely due to the growing use of cottonseed meal. There is a considerable excess capacity for manufacturing inorganic nitrogen.

The quantity of nitrogeneous materials produced in certain sections of the country is considerably in excess of the demand. It is necessary to ship the excess to the Southern and Eastern fertilizer markets.

Activated sludge probably has considerable value as a fertilizer ingredient and can perhaps be sold in small quantities at low prices in most cities near where it is produced. The distance to which it can be transported will depend upon its true value as a fertilizer ingredient and the price of nitrogen in the open market.

More information is necessary to determine the true value of activated sludge as a fertilizer ingredient.

In order to sell the sludge in large quantities to the best advantage, it may be necessary for a municipality to compete in the open market with private concerns producing nitrogeneous materials as a by-product.

There is a very large and growing potential source of organic nitrogen in the garbage produced by the various cities. This garbage carries about 3 to 4 percent of ammonia, 2.5 to 5 percent of phosphoric acid and 0.4 to 1.5 percent of potash. It is therefore somewhat more valuable than sludge as defined herein. If a demand develops for a low grade nitrogeneous material it would seem as though this material would have a considerable advantage as it contains more phosphoric acid and potash.

The average price realized for garbage tankage in Chicago, with average analysis of about 2.5 to 3 percent ammonia, 4 to 5 percent bone phosphate and 0.9 to 1 percent of potash has varied during 1916–1920 between $4.00 and $12.50 per ton. The average price realized by Cleveland with an average analysis of about 3.3 percent ammonia, 11.3 percent bone phosphate and 0.9 percent potash has varied during 1915–1917 between $7.50 and $10.00 per ton.

Many cities are too far from the great fertilizer-consuming centers, for large quantities of the sludge to compete advantageously with the higher-grade nitrogeneous materials, many of which are produced locally. The value per unit of the nitrogen in the sludge may be considerably less than the value of the nitrogen in most of these materials.

The local situation may best be stated by the following quotation from the report made to the Sanitary District of Chicago in February, 1922, by a board of Consulting Engineers, Messrs. Eddy, Fuller and Hatton:

> With the present depression existing in the fertilizer market the sludge produced could not be sold for enough to cover the cost, under local conditions, of converting it into a commercial fertilizer. With more economical methods of sludge handling certain to be developed not only in other cities, but particularly at Milwaukee and at the Calumet and DesPlaines River

sewage treatment works, where facilities have been provided for this very purpose, and with a probable growing demand for low-grade fertilizer, the time may come when it will prove profitable to prepare the activated sludge for sale. As the situation now exists, we are of the opinion that it is not wise for the Sanitary District to attempt this at present.

The commercial future of activated sludge produced from domestic sewage is not clear. Until more data are available on the nitrogen content, its true value as a plant food, the cost of preparation (including dewatering and drying), and until the amount of nitrogen available for fertilizer purposes is well determined, decision should be reserved as to the possibility of a large material return from its sale by works located in the Chicago territory. When proper growing tests have been made extending over several years and the costs of manufacture defined, by actual working results, at the Des Plaines and Calumet plants, and when the probable supply and demand for nitrogeneous materials becomes more clearly defined, then the situation will be somewhat clarified for the Sanitary District.

DISCUSSION

Of papers by Langdon Pearse, page 78; T. C. Hatton, page 96; H. B. Cleveland, page 108; and I. P. Kane, page 113.

Mr. Schaetzle: In view of the fact that Mr. Pearse mentioned Baltimore's sewage-treatment works as the only one from which sludge odors were reported, I feel that something should be said on this matter.

We admit that the scum on the primary settling tanks is malodorous, but the sludge from them, except when being pumped, has given us little trouble in this respect. The report regarding odors from sludge probably emanates from this source: Several years ago we were involved in a number of lawsuits. At that time we were selling liquid sludge to the farmers. Their wagons, of the tank type, were not always water tight and some drippings fell on the road. The Law Department felt that in view of the fact that the adjacent property owners were suing the city and that some of the odors might be due to these drippings, it was best to discontinue the sale of liquid sludge.

The principal point I wish to bring out is the fact that the odor question with respect to sludge at Baltimore must be confined to the raw sludge. When in this condition we admit odors which carry from a half to three-quarters of a mile. Sand-bed-dried sludge is practically devoid of odor.

We are now disposing of this dry sludge to the farmers. We sold it for a time but are now not only giving it away but are loading the farmers' vehicles. Last week we did the loading for as high as 125 to 150 farmers a day. There are no complaints coming in now, and never have, with respect to this particular type of sludge.

Mr. Tark: In this country not much attention has been paid to one point which is thought over very carefully on the other side; the nature of the soil to which the sludge is adapted.

Mr. Osborn: A question is raised by what Mr. Pearse said on the ether extract from sewage sludge. We found in experimental work that the ether extract in sewage sludge runs approximately as stated by Mr. Pearse, and can be recovered.

One thing that is usually overlooked in that connection is the large amount of unsaponifiable greases such as mineral oil. In tests to recover oil it was found to run 8 and sometimes up as high as 40 percent. At the present time there is no market for a grease running as high as 8 percent unsaponifiable.

By-product work on the sewage sludge seems to be a local proposition on account of freight rates and the low nitrates that we have in the sludge itself. It would seem that the ultimate outcome is going to be by the city developing its own market. In other words, there is no question but what there is value so far as the fertilizing elements are concerned, but it will not stand shipping, the freight rate is too high. When we get into low grade fertilizer tankage, local markets can be developed, and have been, whereby the tankage is all disposed of locally, at a much higher price than it can be disposed of when shipped to outside markets that have not been developed.

USE AND ABUSE OF SYSTEMS OF SEPARATE SEWERS AND STORM DRAINS. CAN THEIR FAILURE BE PREVENTED?

By Harrison P. Eddy, Metcalf and Eddy, Consulting Engineers, Boston, Mass.

The object of this paper is to present in a forcible manner the present status of many of the systems of separate sewers and storm drains in this country, to sound a note of warning against a continuance of abuses now more or less generally prevalent, and to offer some suggestions which insofar as they may prove practicable of adoption, may restrain misuse and thus tend to avert a general condition which appears to the author in some specific cases to be little short of an engineering calamity. The membership of this Society perhaps has a better opportunity than that of any other to render helpful service in this field.

Definitions. A committee of the Sanitary Engineering Section of the American Public Health Association has presented the following pertinent definitions:

> A separate sewer is a sewer intended to receive domestic sewage and industrial wastes without the admixture of surface or storm water.
>
> A storm drain is a conduit for carrying off surface water and storm water.
>
> A combined sewer is a sewer intended to receive domestic sewage, industrial wastes and surface and storm water.

Use of Systems of Separate Sewers and Storm Drains. It is not necessary to discuss at length the reasons for the adoption of separate systems or of the combined system. This subject was presented to the Society in 1913 by Professor John H. Gregory in an admirable paper entitled "Separate and Combined Sewers in their Relations to the Disposal of Sewage," and the succeeding discussion. Professor Gregory summed up his discussion with the following statement:

> . . . . no hard and fast rules can be given for the adoption of either the combined or separate system. Each has certain advantages. These as well as local conditions and cost of construction and operation must be taken into account. Other things being equal, especially as more and more attention is being given to the question of sewage disposal, the

separate system seems to offer advantages. With either system, however, to secure satisfactory results too much stress cannot be laid on the necessity of not only proper design but satisfactory maintenance and operation.

Since Dr. Rudolph Hering made his report to the National Board of Health in 1881, the separate system of sewers has had a very large growth in popularity and has been rather generally adopted. No doubt separate sewers have been built in many small communities where sewerage could not have been provided, had only the more expensive combined sewers been available. Separate sewers have been built also in a number of larger cities as New Orleans, Los Angeles and Baltimore, and, in a few cases, as in Boston and Worcester, portions of the existing combined system have been paralleled with separate sewers, and the building connections have been changed to correspond, the former combined sewers having been continued in use as storm drains.

The increase in the number of small villages, towns and cities, many of which have grown up on small streams affording comparatively little dilution for sewage, and the heavy financial burden of providing necessary public works of various kinds, have caused separate sewers to be viewed with much favor. In many cases neglect or postponement of provision for prompt removal of storm and surface water while offering a happy solution of immediate financial problems may have been a policy of doubtful merit.

While some of the views held from 30 to 60 years ago regarding the relation of sewage and sewer air to health, have been modified or found to be altogether untenable, yet today sewers are generally regarded as necessary for the maintenance of the public health as well as for the public convenience. Very properly more weight is given to the latter now than was the case formerly. There is no doubt also that the prompt disposal of storm and surface water has a beneficial effect upon the public health, as alluded to by Mr. L. L. Tribus in his discussion of Mr. Gregory's paper.

Mr. Tribus also pointed out that other elements of cost enter into a proper comparison of the merits of separate and combined systems than the mere cost of the common pipe lines in the highways. Too often comparisons of relative cost have been based upon the bare cost of such sewers, the collateral cost to other municipal departments and to property owners for duplicate connections or other means of disposal of surface water having been disregarded. The inconvenience due to inadequate provision for disposal of storm and surface water has often been given little consideration.

The construction of a system of separate sewers without a system of storm drains, or with only a partial one, has become common practice in small communities and is somewhat prevalent in the larger cities. This has been based generally on economic necessity, either real or fancied as the case may have been. As it is rather unusual to make complete accurate estimates of cost of the two systems under consideration it may add interest to illustrate the subject by a case in which three plans were designed complete and estimates of cost of all three systems were based upon the lowest bid of contractors upon one of the systems. The six proposals were received under the unit price form of contract and were capable of application with a good degree of accuracy to the other two plans upon which bids were not invited.

The sewer district comprised an area of 305 acres. The topography was such that the sewers could be provided with good slopes. Sewers were designed to serve all building lots, and in the case of the partial system of storm drains the drains were provided to serve all the inlets required for proper drainage of the streets, without allowing water to flow across street intersections. The drainage system so built would accomodate 70 per cent of the houses of the entire tract. The ultimate complete development of this district will provide about 7.4 building lots per acre of gross area (including streets). This is equivalent to a total of 2,257 lots. In some cases the sewer and the storm drain connections will be in the same trench in the streets and a portion of the private premises; in others, they will be mostly in different trenches. In many cases the roof leaders will connect with pipes laid outside the buildings, but in some instances they will connect with iron pipes in the cellars. In the estimate which follows the allowances for the house connections are such as to cover, on the average, the several conditions described.

In this illustration the sewers and storm drains were designed to be built in separate trenches except where the drains were 30 inches or more in size. Some reduction in cost might result from putting both pipes in one trench in all cases.

A comparison of costs should include the cost to property owners of the work which they will be required to do, such as the making of duplicate connections, and where drains are not provided the placing of pavement around buildings to receive the drip from eaves and the carrying of roof water pipes under lawns and sidewalks to gutters. In the following estimates, however, only the estimated cost of house connections extending from the common sewers and drains to the soil pipes and roof leaders has been added to the estimated cost of the common sewers and drains. The estimates of cost of the three projects are given in the table.

Estimate of Cost of Sewers, Storm Drains and House Connections,—1920

TYPE OF SYSTEM	COST OF SEWERS OR SEWERS AND DRAINS	COST OF HOUSE CONNECTIONS		TOTAL COST
		Work in streets	Work in private property	
Combined sewers	$476,625 (72.7 %)	$56,425 (8.6 %)	$122,600 (18.7 %)	$655,650 (100 %)
Separate sewers and partial system of storm drains	$477,700 (68.7 %)	$80,125 (11.6 %)	$140,900 (19.7 %)	$698,725 (100 %)
Separate sewers and complete system of storm drains	$524,850 (67.2 %)	$90,280 (11.6 %)	$164,900 (21.2 %)	$780,030 (100 %)

The estimates indicate that under the conditions of this case the combined system would be substantially cheaper than the system of separate sewers and a partial or incomplete system of storm drains, and considerably less expensive than the complete systems of separate sewers and storm drains. Of the total expenditure approximately 30 per cent is required for house connections and drains around the houses to collector of water. About two-thirds of this amount is for work in private property.

Such estimates are open to attack on a number of grounds. It is seldom that all abutting lots are built upon at the outset An adjustment in costs might therefore be made on account of saving in interest. More important would be the probable saving due to the postponement of construction of some of the drains. The estimate therefore is applicable only to this specific case and is used merely to illustrate general tendencies.

Abuse of Separate Sewers and Storm Drains. Mr. Gregory made no specific mention of the abuses so prevalent in the case of separate sewers, altho he may have had them in mind when laying stress upon "not only proper design but satisfactory maintenance and operation." In the discussion of his paper, however, Mr. E. S. Rankin pointed out the difficulties of administration, stating that "As a matter of fact it has been found impossible to entirely prevent such connections" (the connection of roof leaders).

In a paper entitled "Prevention of Misuse of Sewers"[1] Mr. W. H. Dittoe has stated clearly the manner in which storm drains and sewers are being misused, as follows:

> Sewers are designed for definite purposes and if used for other purposes are being misused. Storm drains are misused if receiving sewage, industrial wastes or other wastes of objectionable character. Combined sewers are properly used when removing all classes of liquid wastes, but are misused if receiving industrial wastes affecting sewerage systems or processes of sewage treatment.
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> Sanitary sewers, as the name implies, are for sanitary purposes only, and are misused if they receive drainage from the surface and roofs, subsoil drainage such as may be admitted by building foundation drains and thru open or leaky joints, and industrial wastes of a character to affect the sewage or treatment processes.

Combined systems with intercepting sewers and storm overflows permit the discharge of sewage mingled with storm water thru such overflows into water courses. In general the total quantity of sewage (not including storm water) thus discharged probably aggregates from 2 to 5 percent of the total quantity produced during the year. One of the important objects of separate sewers is to prevent this periodic discharge of sewage into small streams and bodies of water.

In many cases, however, sewage is discharged into storm drains thru incorrect house connections, and even common sewers which have been connected with storm drains. This, in greater or less measure as the case may be, defeats one important object of the adoption of the separate system in preference to the combined system. Such discharge is not confined to periods of storm, but is continuous and may readily constitute a greater source of pollution and offense than sewage discharged from combined sewer overflows in times of storm. Only from 2 to 5 per cent of the building connections wrongly made would be required to provide a quantity of sewage equal in the aggregate to that discharged from combined sewer storm overflows. In many cases the continuous discharge of sewage from even a smaller proportion of the houses would constitute a greater source of annoyance on account of its discharge in dry weather and at times of low stream flow.

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[1] Proceedings American Society of Civil Engineers, vol. xlvii, page 642.

Great annoyance and damage have resulted from the discharge of storm and ground water into separate sewers. This occurs thru the connection with the sewers of roofs, street inlets and foundation and cellar drains, and in some cases even small brooks. Sewers are sometimes so poorly built that they receive large quantities of ground water that should be cared for by natural channels or storm drains. Even where the sewers are most carefully built to exclude extraneous water the house connections are often so improperly made that large quantities of ground water find access to the sewers, thus nullifying the effort and money expended in securing excellence of workmanship in their construction.

The results of such abuses have been serious in many places. In others, however, the ill effects have not yet been so important, because the improper connection of roofs and inlets and the faulty workmanship upon sewers and house connections go on gradually and considerable time may be required for their cumulative effect to become such as to cause damage and demand public attention. The effect of such abuses is destined to increase greatly as time goes on.

In one case a city has been compelled to approximately double the size of its sewage treatment plant, solely because of the admission of water to separate sewers. The sources of this water were many, including defective house connections, street inlets, perforated manhole lids particularly within street car tracks, and abandoned house connections which were not sealed when buildings were burned or removed. One of the most important sources in this case appears to have been wet cellars from which water was drained to the separate sewers thru the cleanouts in cast-iron soil pipes laid below cellar floors. There are many buildings located on side hills in some of which there is ledge. During and after rains, large quantities of ground water enter the cellars, and the owners, or tenants, remove the caps from cleanouts and allow the water to drain out. In some cases the cleanout caps have been left out continuously.

So large a quantity of water is admitted to the separate sewers in this city that the trunk sewer some three miles long is often overtaxed, and occasionally the sewage has escaped thru the manhole covers into the streets and run over the ground into a neighboring water supply reservoir, which, finally, was protected by sand filters built to receive the sewage before it could reach the reservoir. The trunk sewer should be augmented now, altho it is of ample size to serve the city adequately for many years to come were it not for this abuse of the separate sewers.

Considerable money has been expended in an effort to remedy the defects in this system. Street inlets have been disconnected, perforations in manhole covers have been closed by means of rivets, abandoned house connections have been sealed, and one sewer has been rebuilt, but the net result of this work has been small. It is practically impossible to correct many of the defects. Fortunately the growth of the city has been comparatively slow and the separate sewers are serving a useful purpose notwithstanding their defects. However, from the point of view of the service which might be rendered by the system under reasonably favorable conditions, it has failed in large measure.

Probably few systems of separate sewers have been so designed that they can receive the roof water from more than about 1 percent of the tributary houses without being surcharged at times of intense downpours after the districts they are to serve shall have been built up to the extent contemplated in the design. If there are also other sources of admission of water, such as street inlets and perforated manhole lids, the number will be correspondingly less.

In some places the sewers have been surcharged to such an extent that sewage has flowed back thru house connections into the cellars, while in others it has escaped thru manhole covers into the streets. Just how far such conditions can be tolerated without justifying the statement that the sewer system is a failure, is a debatable question.

In a certain city a very large number of incorrect house connections to separate sewers and storm drains were found in one district comprising only about 300 acres. The authorities made a strenuous effort to have the errors corrected by the property owners, with the result that nearly all, *but not all*, the required changes were made.

Such abuses may ultimately require enlarged treatment and pumping plants, increased operating expenses and augmenting the sewer systems, first by relieving the main sewers, and later the submain sewers and perhaps even the lateral sewers.

It is believed that these are not isolated cases and that these conditions are rather general. On the other hand, some systems have been satisfactory. This is probably particularly true in very small slow-growing communities and where the local administration has been good.

Causes of Misuse of Separate Sewers and Storm Drains. The principal causes of the misuse of separate sewers and storm drains may be grouped in six classes as follows:

First, ignorance of the purpose and objects of the sewers and drains is an important cause of their misuse. This ignorance is often due to lack of proper instructions from those designing the systems. It is due also in many cases to frequent changes in administration, as a result of which officials many times are entirely ignorant of the intent and plan of the systems. Sometimes many, or all, of the records and drawings are lost or have never been properly filed for available use in the municipal offices. In such cases whatever knowledge there may be is often lodged in the minds of a few tradesmen such as building contractors and plumbers. In some places this knowledge is a portion of their stock in trade. They make the connections for the building owners, sometimes in the cheapest possible manner, regardless of known proprieties, and in others incorrectly, through ignorance.

Second, misuse has arisen also from indifference of municipal officials. In one instance coming under the author's observation the city officials having jurisdiction over the making of house connections and the operation and maintenance of the sewer and drainage systems, apparently made no effective effort to secure correct connections, notwithstanding that they were formally notified of the intended use of the sewers and drains, of the fact that connections were being improperly made, and that a continuance of the existing policy would thwart the plan adopted for maintaining the natural water courses in a clean presentable condition and would result in the surcharging of the separate sewers and in injury to property due to flooding, for which the city might be legally liable in damages. Such indifference may arise from many causes some of which naturally fall under the other groups herein discussed. Probably the most important is the lack of moral stamina to require the making of proper house connections by building owners, notwithstanding their protests urged as a matter of personal privilege.

Third, lack of authority to enforce suitable regulations has been a cause of misuse in some instances. Where there is no state law or municipal ordinance the city official having jurisdiction must assume the authority, which requires a strong personality. An official assuming such authority will often find himself without the support of superior officials.

Fourth, favoritism or "pull" has undoubtedly played an important part in permitting the making of incorrect house connections. While the relative number of cases which can be so classified may be small, their existence tends to undermine the authority conveyed by law or assumed by the official in charge. If there is precedent for disregarding regulations, many requests for such privilege are likely to follow. It is cheaper to lay one connection than two. A building may be provided with a sewer connection, and later the discharge of roof water on to the ground may become a cause of annoyance. It is obviously a simple matter to discharge this roof water into the soil pipe connected with a separate sewer, and the owner is likely to feel that it is a great hardship to be obliged to lay a new connection all the way from his roof-water pipe to the public drain. Additions to buildings frequently require the disposal of surface water. These additions may be very small, such for example as a bay window or piazza, and the official who has the moral stamina to require the owner to lay a connection to the public drain for the purpose of serving such a small addition, is likely to be severely criticized by the owner.

Fifth, surreptitious connections undoubtedly have been an important cause of the misuse of sewers and drains. In many cases, particularly in times of high cost of construction work, building owners uudertake to make certain improvements or repairs directly, or thru the employment of journeymen mechanics. Often too it happens that such mechanics are the owners of buildings, and it is natural for them to do their own work where practicable. Over such work the city officials have no control, as application for permits is not made. Building owners are often annoyed by surface or ground water where no drain is available for its reception. Explanation and argument on the part of the city official usually afford the owner little satisfaction. This is particularly true in cases where he has paid the same sewer assessment as his neighbor in front of whose property a storm water drain was constructed. The owner who lacks the drainage facilities is certain to feel that he has been inequitably treated, and there is no doubt that in many cases he has attempted to square accounts by making the needed connection with whatever pipe was available and without the knowledge of the officials. The discharge of cellar drainage thru the soil pipe cleanouts has already been discussed.

Sixth, in a relatively few instances misuse has undoubtedly been due to incorrect connections made thru error. In some cases the pipes between the building and the public sewer are laid in advance of the installation of plumbing. Later the plumber may readily mistake the sewer connection for the drain connection and transpose the tributary pipes within the building. In other cases the plumbing is first to be installed and the drain-layer may erroneously connect the soil pipe with the drain and the roof-water system with the sewer. Probably such errors constitute the least serious of the causes of improper connections.

Remedies for Misuse of Separate Sewers and Storm Drains. Great care should be exercised in the selection of the type of sewer system to be installed. It should not be assumed that separate sewers are more advantageous, but conclusion should be reached only after careful study of all the conditions, including comparative estimates of cost. In making such studies due weight should be given to the value of the opportunity for disposal of roof water into sewers and to the inequity of affording such facilities to a portion of the property owners and withholding them from others. It may be accepted as a fact that residents will not tolerate standing water in their cellars. In thickly settled communities water cannot be allowed to flow over sidewalks to the street gutters, and, at least in the northern portion of the country, roofs and areas cannot satisfactorily be drained into gutters by pipes passing under sidewalks. Topography, character of soil, climate, present and prospective density of population, frequency and intensity of precipitation, as well as conditions influencing the problem of sewage disposal, are among the important considerations bearing upon such a selection.

It is possible that the zoning system, which is now being favorably considered in many American cities, will simplify the problem of determining the character of sewerage and drainage works to be provided. Whereas formerly it was impossible in many instances to forecast with accuracy the character of development which was likely to take place in the different portions of a city or to provide systems to meet all contingencies, the zoning system now facilitates more accurate forecasting of future sewerage and drainage requirements and there is greater assurance that the assumed future conditions will be realized.

The so-called "English system" has been advocated by some. In this allowance is made in the separate sewers for such roof water as abutters may choose, or may be permitted, to discharge into them. In some places the unlimited disposal of roof water in this manner would result virtually in a combined system, since roof areas may well equal street areas and where the community is thickly settled the extent of roofs amy be three or four times that of the streets. It is doubtful, therefore, if the "English system," so-called, is of very general application. It must be conceded, however, that some extraneous water will reach separate sewers. Some roofs will be connected thru error or surreptitiously. Some cellars will be drained, and some defective connections with sewers are inevitable. Reasonable allowance must therefore be made for such conditions.

Far greater care should be exercised in the construction of separate sewers than has been the case in many instances, in order that the sewers may not become overtaxed because the admission of large quantities of ground water.

Greater effort should be made to secure excellency of workmanship in the construction of house connections. In many cases sewers have been laid in an excellent manner and have been reasonably watertight. Later, however, thru carelessness in the making of house connections these systems have been subjected to serious abuse. Mr. Dittoe[2] has suggested that,

> . . . . The most logical and effective method of accomplishing this is the construction by the municipality of all connections to the public sewers

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[2] Proceedings, Am. Soc. C. E., December, 1921.

> from the building to the street sewer and the continuation of municipal control over such connections after they are constructed. The sewer department would organize its construction gangs for this work or would enter into annual contracts with responsible contractors, and the property owner would pay to the city the cost of construction, inspection, and recording.
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> . . . . It is believed that this method of construction would insure better construction of the connection at lower cost, would largely prevent the misuse of sewers, and would assist in securing efficient operation of sewage treatment processes. Incidentally, it would probably arouse a more lively interest on the part of the city officials in the management and maintenance of the sewerage systems and would likewise remind the public that the system is an important feature of the community development and must be controlled in a business-like manner if its value is to be realized.

There is much to be said in favor of Mr. Dittoe's suggestion. Where connections are made by contractors, however, they should be licensed annually and should give bond for the faithful performance of their work.

More effective control of the construction and maintenance of house connections should be secured in many cases. Generally such control should be vested in the official in charge of the sewer system. When connections are to be made written applications therefor should be filed, and written permits for the connections should be issued. The official in charge should be notified when the work is to be done and should provide for the necessary inspection. A record of permits issued and used should be kept in a book provided for this purpose. The inspector's work should also be made a matter of record.

A few years ago the author had opportunity to observe the character of construction and inspection of house connections in Manchester, England. In this case the connections were completed before the inspector visited the work. The pipe line, however, was left entirely exposed, including the portion of the public sewer affected by the connection. Upon arrival of the inspector a plug was inserted at the branch in the main sewer and the connection subjected to slight hydrostatic pressure. In this instance there was no measurable leakage. Obviously the connection was approved.

Coöperation between certain municipal departments is very important in securing satisfactory plumbing and house connections. The extent of such coöperation of the departments affected depends upon the local system of conducting the municipal work. The department which has charge of plumbing inspection should require the filing of sketch drawings showing the work contemplated. Before issuing permits for such plumbing these drawings should be submitted to the official in charge of the sewers, for his approval. If the drawing shows erroneous connection of roof water and fixtures within the building, the sketch should be returned to the plumbing contractor for the necessary revision. Until the drawings have received the approval of the sewer official the plumbing permits must not be issued. It is necessary that the plumbing inspectors understand the importance of the separation of roof water from sewage and that they shall conscientiously carry out the regulations to that effect.

It is also advisable to provide against incorrect connection made thru error. In the city of Philadelphia the usual sewer and drain connections are 5 and 6 inches in diameter, respectively. Thus it is easy to determine with which pipes the plumbing systems should be connected. In another instance the bells of the cast iron pipes inserted into the foundation wall by the drain-layers are painted white in the case of storm-water drains, and black in the case of sewers.

Complete and accurate records and record drawings of all sewers and drains should be filed in the municipal offices in a manner which will make them readily accessible for reference. As suggested by Mr. Dittoe,[3] instructions as to the proper use of the systems should be provided by the engineers having in charge their design. Such instructions should be in permanent form and so placed, filed and disposed as to be always in evidence and available. Wall maps, house connection application blanks, permit books and permit blanks should have displayed prominently upon them the proper restrictions upon the use of the sewers and drains.

Suitable statutes or ordinances should be enacted to provide for the proper regulation of house connections. It is expecting too much of city officials to rely upon them to enforce such regulations unless they are specifically set forth in the state laws or in the municipal ordinances. Appended hereto are excerpts of a few laws and ordinances which are typical and may be suggestive to any reader who may be interested in framing a similar statute or ordinance. While a state law is applicable to all municipalities within that state, it may lend local assistance to have in addition thereto the same regulation embodied in the municipal ordinances.

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[3] Proceedings, Am. Soc. C. E., December, 1921.

While much can be accomplished by such measures as have been suggested herein, after all, the success of systems of separate sewers and storm drains must depend primarily upon the integrity, loyalty, knowledge and backbone of the city officials in charge. They should recognize that it is one of their important duties, for the faithful performance of which they have taken oath, to see to it that the sewer and drainage systems are not misused and abused. There is no doubt that in many instances the strict performance of their duty will be unpleasant. In certain aggravated cases such performance of duty will doubtless result in a search for a new position. Nevertheless, it is the author's firm conviction that in many cases systems of separate sewers and storm drains can be saved from failure only by the loyal performance of this duty by the city official upon whom the responsibility devolves.

ADDENDUM

The General Laws of the Commonwealth of Massachusetts, 1921

Chapter 83, Section 5. In this section surface or storm water and such other waters as shall be specified by the department of public health shall be designated as waters and all other waters and sewage shall be designated as sewage. When a town has provided both a drain for waters and a sewer for sewage in a public way, the owner of every parcel of land abutting on such way or connected with such drain or sewer shall arrange his plumbing so that the waters shall be kept separate from the sewage; and shall make such connections with the drain and sewer respectively that the waters shall pass into the drain and the sewage into the sewer in accordance with the directions of the board or officer having charge of the repair and maintenance of sewers in such town.

Revised Ordinances, City of Worcester, Mass., 1909

Chapter XXX, Sec. 2. The plumbing and draining of all buildings, public and private, shall be executed in accordance with plans and specifications previously submitted to and approved in writing by the Board of Health. Plans and specifications of such plumbing and drainage shall in each case be submitted upon blanks in such form as the Board of Health shall order and placed on file in the health department. No person shall commence work on such drainage or plumbing until such plans and specifications shall have been submitted to and approved by the Board of Health and a permit issued therefor. . . . .

Chapter XXXIV, Sec. 4. The superintendent of sewers shall grant permits to individuals to enter the drains into the public sewers and drains, in accordance with the terms of this chapter and the rules and regulations made therefor by the City Council, and shall keep a complete record, in books made for that purpose, of such permits, giving the name of the street, and the number of the estate, if any, name of the owner, size and kind of side drain entered, and the name of the drain layer making the entrance, and such other facts in connection therewith as may be of importance as matter of record.

Chapter XXXIV, Sec. 5. Applications for permits to connect any private drain with a public sewer must be made in writing to the superintendent of sewers, by the owners of the property to be drained, or by their authorized attorneys. Said application must be accompanied by a clear description of the premises to be drained, and drains required.

Chapter XXXIV, Sec. 8. Drains and private sewers connecting with public sewers shall be of such size, and laid at such grade, and at such depth as the city engineer or his assistant shall direct. The expense of such engineering, not exceeding fifty cents for each hour or fraction thereof for the engineer, and twenty-five cents for each hour or fraction thereof for the rodman, shall be paid by the drain layer applying for the permit, upon the completion of the work. . . . . All work of every kind connected with the laying of such drains, including all repairs, shall be subject to inspection by the superintendent of sewers and be done to his satisfaction.

Chapter XXXIV, Sec. 14. No roof water, surface drainage, or other unpolluted water shall be turned into a sanitary sewer, but may be turned into surface water drains wherever such drains are provided. On hill tops and in other places where it is not intended to provide surface water drains, all roof water and surface drainage may be discharged directly on to the premises of the abutter or into the street gutters, and all pipes or conduits passing under or thru sidewalks shall be of such material and pattern and constructed in such manner as shall be directed by the street commissioner. No surface water shall be so discharged as to flow over or upon sidewalks. In sections of the city provided with combined sewers and where surface water drains are not provided, surface water may be discharged into said sewers thru pipes separate and independent from pipes carrying sewage, and such pipes shall be laid at such grades, depths and to such points as shall be required by the city engineer, so that they may be at any future time disconnected and connected with main surface-water drains.

Chapter XXXIV, Sec. 16. No person as a drain layer shall make any entrance into any sewer unless he be duly licensed by the License Board; and such person so licensed shall give a bond, in a sum not less than one thousand dollars, for the faithful performance of such work as he may execute, and to make good any defects which may appear in any sewer, street drain or work done by him, and to remunerate the city and any person for loss or damage occurring in consequence of any act done under any permit granted him.

Chapter XXXIV, Sec. 18. Any drain layer violating any provision of this chapter shall, in addition to the general penalty provided for the violation of these Revised Ordinances, forfeit his license.

Revised Ordinances of Brockton, Mass., 1899

Chapter 5, Sec. 36. No water shall be discharged from the roof of any building, so as to flow along or across any sidewalk upon any street in which a public drain has been laid; and the conductors for such water shall be made by the owner of such building to connect with such drain, under the direction of the committee on sewerage and drainage on the part of the board of aldermen, or such person or persons as they may designate thereto.

Chapter 28, Sec. 8. No person shall enter, or attempt to enter a private drain or sewer into a common sewer or its connections, or into the underdrain constructed in connection therewith, unless he is duly licensed thereto, and no person shall cut into, interfere with, or obstruct a common sewer.

DISCUSSION

Mr. Folwell: It so happens that I have for my paper exactly the same title as Mr. Eddy's paper. I didn't know until I reached here that he had such a paper. He has covered, naturally, all the ground that I would cover, and more; but I had, thru the Secretary, obtained some information on this point thru a questionnaire and I thought that the members of the Society were entitled to receive the information so obtained, and while I won't burden this meeting by reading the data (I will have them published in the Proceedings) I will give a summary here of what was discovered.

The misuse of sewers was the subject of a paper read by W. H. Dittoe, Chief Engineer of the Ohio State Department of Health, before a symposium on Stream Pollution as Sewage Disposal, arranged by the American Society of Civil Engineers during the New York Convention of the American Public Health Association last winter. Mr. Dittoe stated that "the purpose of this discussion is to call attention to the abuse of sewerage and sewage disposal systems resulting from failure of municipal officials to control properly the establishment and use of connections to sewers. "Storm drains are misused if they receive sewage, industrial wastes, or other wastes of objectionable character. Combined sewers are properly used for the removal of practically all classes of liquid wastes, but are misused if they receive industrial wastes affecting the sewerage system or process of sewage treatment. Sanitary sewers, as the name implies, are for sanitary purposes only, and are misused if they receive drainage from the surface and roofs, subsoil drainage such as may be admitted by building foundations, drains and thru open or leaky joints, and industrial wastes of a character to affect the sewerage system or treatment process."

Mr. Dittoe placed emphasis upon the prevalence of such misuse of sewers to a greater or less extent, and the serious results of such misuse upon the treatment of sewage, the proper operation of the sewers and the health of the community.

In order to obtain some idea of actual conditions in connection with sewer misuse, the writer requested the Secretary of this Society to submit a few questions on the subject thru the medium of a questionnaire. Unfortunately, not many replies to these questions were received, probably because, owing to the very nature of the subject, little definite and exact knowledge on the subject is had in most cities. A general summary of the replies is given below for the information of city engineers and other members of the Society.

The question was asked to what extent sewage from houses or elsewhere is discharged into storm-water sewers, or drains, either under permission or regulation, or surreptitiously. Fourteen cities replied that this practice was not permitted; six that it was permitted, a seventh that it was permitted under temporary permit of the Board of Health in streets that were not yet sewered, and two that it was permitted under regulations. As to whether this was practiced surreptitiously, nine stated that it was to a small extent, one that about fifty instances could probably be found and seven that there was no such misuse.

To the question, to what extent industrial or objectionable wastes (including laundry wastes) are permitted to be discharged into storm-water sewers, or drains, nine replied that this was permitted, ten that it was not permitted, one that it was permitted for laundries; while to the question whether this was done surreptitiously, four stated that it was not; four that there was a greater or less amount of such misuse, and another that it was confined chiefly to garages.

Some industrial wastes are known to interfere with the treatment of sewage, and to the question as to the discharge of such wastes into sanitary sewers, seven replied that there was no such discharge in their city; four that there was more or less, while a fifth specified two creameries, a sixth a gas plant, and two others stated that all industrial wastes were discharged into the sanitary sewers. In the case of combined sewers, eight stated that there was no such discharge; four that there was a slight amount, and two that all wastes reached sewers. Eight reported that discharge of these materials was done under permission and regulation by the city, four stated that no such discharge was done surreptitiously and five that there was more or less surreptitious discharge of such materials.

As to the kinds of industrial wastes reaching the sewers, three reported that wastes from tanneries and glue factories containing hair and lime reached the sewers; three reported wastes from textile industries containing cloth, fibrous material and objectionable compounds and solutions; three reported wastes from canning factories, two from stockyards, six from packing and rendering plants, one from wool-washing plants, four from dye works, ten from creameries, three from gas factories, eleven from garages and two acid wastes from metal factories.

Admission of Storm Water

The question was asked to what extent roof leaders and area drains discharge into sanitary sewer, and four replied that such use was permitted, thirteen that it was not permitted, and two that there were a certain number of cases permitted. Four said that there was no surreptitious practicing of this, and seven that there were a few instances; but several others reported that "many" had infringed, "a vast number," "hard to control," etc.

The admission of subsoil drainage to sanitary sewers from cellars, foundations, etc., was reported as permitted in seven cities, as not permitted in one city and as not practiced in six cities. The amount entering the sewers from leaky joints was reported to be none in two cities, small in one city, while others reported that it amounted to about 20 per cent of the flow, 10 to 15 per cent, "considerable," "quite extensive," and others stated that it was "difficult to avoid," "difficult to determine," "unknown," etc.

In some cities storm water is admitted thru inlets to the sanitary sewers, either from streets or other public thorofares, or from ditches or other open water courses. Fourteen reported that no storm water was admitted from streets, one reported that it was so admitted from all paved areas, five that there were some instances of it, and two that there was only one such instance. Admission from ditches and open water courses was reported from only two cities.

In general, the replies indicated a greater amount than had been suspected of permitted use of the different classes of sewers for purposes for which they are not theoretically adapted, and which the writer believed are objectionable and should be eliminated wherever it is at all possible. As already stated, there is probably a great deal of surreptitious misuse of sewers in the manners indicated, of which the authorities have no knowledge but which should be discovered and stopped. The writer believes that, in view of the millions of dollars invested in sewers and sewage-treatment works, this subject has not received the attention which it deserves from municipal authorities.

SECRETARY BROWN: We have had cases of overflow of sewer into the street. The separate house sewers were built some years ago, too small in the first place and now overcharged by extensions and by building up of the districts thru which the old sewers were built. The joints were not well filled and there is much infiltration of ground water. During the season, winter and dry, these sewers are able to take care of the sewage, tho it is greatly increased in amount by the influx of tourists. In the rainy season the amount of ground water is so great that it fills the sewers and there is not room for the sewage. On account of the difficulty of constructing sewers in water-filled sand and because there is no danger of freezing the house sewers are near the surface and the over crowding of the sewers is so great that before it produces head enough to force the water thru the pipe, it overflows onto the surface of the street or alley. In one case the sewer was connected temporarily with a storm water drain, to prevent the overflow. This is not seriously objectionable as the overflow occurs in the rainy season when the storm drains are flushed out frequently.

A new system of sewers is being designed which will cut off enough of the upper portions of the overloaded sewers to make these overflows unlikely, so that the condition will soon be remedied.

T. C. HATTON: Mr. Chairman and Gentlemen: Mr. Eddy's paper is very enlightening and very instructive, but it does not solve the problem. For instance, Milwaukee is not unlike many other cities in the United States with which I have acquaintance. It is extending its sewerage system outside of the old city limits and taking in the small towns in the immediate neighborhood, which have supplied themselves, from time to time, with so-called separate sewerage systems. Few inspections have been made of those systems or the connections made with the sanitary sewerage system by the state inspectors. With five state inspectors covering a state as large as nearly all of New England, you can readily understand that it is hard to find whether a man puts storm water connections from the house in with the sanitary sewerage or in the storm sewer.

As a matter of fact, in extending our metropolitan sewerage system to take in these outlying districts, we have found not hundreds, but thousands of cases in which the owners thought they were doing all right, and the owners who purchased from the first owners thought they had their system all right. So, we find that two-thirds of the houses which should be connected separately with the two systems are connected jointly with the sanitary sewerage system.

There is one town of possibly eight or ten thousand inhabitants for which we have to provide which has its own water supply which is very hard, and which can not be used very well for laundry purposes, so they have erected, in nearly all cases, cisterns in their cellars, turning their roof water into these cisterns, with an overflow into the sanitary sewer or rather into the lateral branch leading into the sanitary sewer. There is absolutely no opportunity without an extensive storm-water system thruout that city to overcome this difficulty, and yet the intercepting sewer system in the city of Milwaukee has been designed and built with a view of not taking in that storm water. I ask you, what are we going to do with that. I cannot demand the expenditure of not thousands of dollars but hundreds of thousands by these property owners for changing the entire plumbing of their houses, over the district in order to overcome this difficulty. It isn't a question, gentlemen, of surreptitiously connecting with the separate system in city property, but it is the work that is done outside of the city which comes into the city finally. That is the difficulty which confronts the engineer who is planning sewerage systems from time to time, from the outlet up to the intake.

If an intelligent aggregation of men like this can solve that problem I will feel that my membership in this Society has been well paid for.

President Rankin: I am pleased to hear Mr. Eddy say a good word for the combined system of sewerage. It has seemed to me that for some time the pendulum which was on the extreme tip years ago when everything was combined and swung to the extreme right when everything was separate was beginning to get back where it belongs and that there are good things in each system.

Mr. Walter W. Graf: We are up against a very serious proposition in Lancaster, Ohio. Lancaster is probably two-thirds sewered with the combined system. The State Board of Health now refuses to approve any more plans for this system. Every new outlet into the river must be a separate-system sewer.

The city has always paid on the combined sewers, owing to the fact that the street storm water is handled by them, 35 per cent, plus the cost of street and alley intersections, which makes approximately 50 percent of the entire cost of the sewer, and the property owners in the sewer district pay the remainder of the cost. Any property owner in the district may tap the combined sewer for sanitary purposes without any additional charge. A tapping permit is required, but no charge is made for same.

Now comes our order for a separate system of sewers and the complication of assessments, the storm sewers being paid for on the old basis of practically fifty-fifty and the council deciding to assess the sanitary sewers at the rate of ninety percent against the abutting property owners and paying ten percent out of the city funds, raised by general taxation. Consequently it is costing the people in the new parts of the city a much higher rate for sewerage than those sections which have combined sewers. Extensions made today in old sewer districts having the combined sewers cost in many cases less than half of those made in districts having the separate system, the older districts in most cases having the most valuable property. This is a difficult proposition to explain to property owners who think they are being discriminated against.

It is another problem similar to the one the gentleman from Milwaukee has to solve. It is a hard one to know what to do with.

Some day we will possibly have to build a sewage disposal plant. This will mean an intercepter along the river to take the sewage all to one point and the assessment question will again be a complicated one.

I have often wondered if the combined system is such a bad thing that it could not be continued in a city like ours and if the State Board of Health are altogether right in ruling against this system. Like Mr. Rankin, I am pleased to hear Mr. Eddy say a good word for the combined system.

Mr. Greeley: The state of helplessness appearing to result from this abuse of sewer systems has already been indicated in two or three of the discussions and I hesitate to add additional discussion. I think, however, by way of warning to some towns which are now on the way to this condition, that their attention should be called to special cases.

We are now studying the sewerage systems of a half dozen towns with populations from ten to forty thousand where sewer extensions have come to practically a dead stop. New houses being built further up on the city streets and desiring sewer connections find that the property owners down street on the sewers raise sufficient objections to any further extension of the already surcharged sewers, so that the authorities can not go ahead with those extensions. And the state of helplessness that has resulted in these extensions is, in some cases, serious and pathetic, and should speak for an early scrutiny of such conditions so that the state of deadlock does not come too quickly upon the community.

With reference to the correction of these troubles, I have in mind one project in this state, of a town of some forty odd thousand with a river frontage of about six miles. In the older portion of the town we devised new sewers so that the entire scheme could develop on a combined system and such abuses as have already occurred would be corrected in that way, with least interruption of service. This met with the approval of the State Department of Health. In another part of the town where sewage treatment was needed immediately and on account of its relation to the water supply, separate sewers were planned. Both systems were in the same town, but at considerable distances from each other.

RECENT DEVELOPMENTS IN SEWAGE TREATMENT

By George W. Fuller, Consulting Engineer, New York City

The purpose of this paper is to outline briefly some of the recent developments in this important field of municipal improvements, partly to indicate the trend of progress within the range of the writer's observations, and partly to facilitate discussion on the tendencies now revealed as to the selection of types of plants for projected installations. A review of observations and experiences in a field as great as this can at best hit only a few of the high places and no attempt will be made to deal with technical details.

Skimming Tanks

At Toledo a pumping station is about completed which will deliver sewage from the intercepting sewer system into a "skimming tank," prior to dispersion of the partly clarified sewage thru submerged multiple outlets, 10 in number, near the channel of the Maumee River and about 550 feet from shore.

This skimming tank receives the sewage after it has passed thru cage screens with a double set of bars having about 0.3-inch openings in the direction of flow; and in it the sewage will rise to a sufficient elevation to provide head for its discharge thru the outfall pipes. The sewage in the tank has a circulatory movement due to the arrangement of the inlet and outlet. This causes an eddying effect so that the floating materials will rise to the surface, allowing grease to become attached to match stems, corks and other solid matters which will be removed from time to time by skimming the surface.

This device is closely similar to the skimming tank at Washington, D. C., which is described in the author's book on Sewage Disposal, page 405, and which has attracted much favorable comment, because of the elimination of floating matters of sewage origin from the vicinity of the submerged outlets in the Potomac River.

The skimming tank at Toledo is arranged so that its performance may be supplemented at some future date by fine screens.

Fine Screening

Usefulness. The usefulness of fine screening is indicated by its recommendation or adoption at a number of important projects for ocean outfalls and sewers discharging into tidal estuaries. Its adoption has been recommended at Los Angeles, Cal. and its use along the water front of New York City still continues, as shown by recent lettings for fine screens for sewers discharging into New York Harbor.

Probably the largest fine screenings projects now under consideration relate to use in connection with the activated sludge process at Milwaukee, Indianapolis and Chicago, where it is believed that the removal of the coarser sewage matters will improve practical operating conditions and effect economies amounting to more than the cost of fine screening.

Fine screens are also very helpful in many cases in removing sewage solids, to prevent clogging of nozzles of trickling filters, either in connection with or independent of preliminary sedimentation.

Types. Recent developments in mechanically operated screens show that manufacturers are giving much attention to this type of device. The Riensch-Wurl screen, such as adopted for Bridgeport and described by Mr. McElroy in the 1920 Proceedings of the Society has found competition from cheaper types, such as the Dorr screen installed at New Britain, Conn. and Bethlehem, Pa., the Link-Belt Company screen at Pleasantville, N. J. and the Rex screen as developed at Milwaukee by the Chain Belt Company. At Indianapolis, Mr. Hurd has designed a drum screen which is being built by the Chain Belt Company at Milwaukee. To what extent cheaper types of screens will pass thru experiences calling for heavier construction to make them durable, as was the case with the Riensch-Wurl screen following its extensive use in Europe, remains to be seen and need not be discussed here.

Disposal of Screenings. Probably the simplest way of disposing of screenings is to turn them over to the local garbage and refuse department. This is done at the Dyckman Street plant in New York City and the screenings are barged to sea. Screenings may also be sent to a dump and covered promptly and adequately with earth so that they will not produce a nuisance. At Rochester it is understood that the covering is made with material removed from the grit chamber and that the quantity of this material is not always sufficient. At New Britain the screenings are lifted from the chamber, in which a Dorr screen is placed, by a bucket elevator with perforated buckets so as to remove free water. The screenings are taken to a dump at an isolated site. Such dumps, if not covered with earth, may or may not give trouble from odors or flies. At Washington, Pa., the screenings are removed from the dump only once or twice a year just prior to spring and fall plowing, and not always completely on these occasions. The screenings from the plant are removed by a wheelbarrow on a run-way arranged so as to permit, when necessary, of an adequate application of chloride of lime.

Fine screenings accumulate at the rate of 12 to 15 cubic feet per million gallons of domestic sewage and in many cases are applied directly to land. This is done at Plainfield, N. J., day by day, where the screenings discharge directly into a manure-spreader from which they are applied to land and plowed in at frequent intervals during the warm season of the year.

Burning of screenings was practiced for some time in an oil-fed incinerator at Long Beach, Cal., but this whole plant, while seemingly working well at first, has been greatly overtaxed so that helpful data are not now available.

At Indianapolis Mr. Hurd proposes to mix the screenings with the settled sludge from the sedimentation tank of the activated sludge process and dewater the mixture.

Imhoff or Two-Story Tanks

Generally speaking the flowing-thru compartments are made somewhat smaller than was the practice some 10 years ago, whereas all sludge storage and handling arrangements are made substantially larger than formerly. Even under these conditions two-story tanks while found to be efficient clarifying arrangements are not free from complications as to incomplete sludge digestion, foaming at gas vents, accumulations of floating sludge, and the release intermittently of large quantities of gas, so that on some occasions odors are transmitted for considerable distances.

Upper Compartment. The flowing-thru compartment is now ordinarily built of a length of about 70 to 90 feet. Longer tanks are scarcely worth while because there is very little increase in clarification after the sewage has traveled from 30 to 50 feet from the inlet. Thus with the shorter tanks, upon reversing the flow, the sludge is quite well distributed in the digestion chambers. Linear velocities should not exceed about 1.5 to 2 feet per minute under ordinary conditions. Velocities in excess of 2.5 feet per minute show a falling off in the removal of suspended matters. Detention periods earlier figured at two to three hours may well be cut in two for average flows, without affecting the degree of removal of suspended solids.

Vents. These should occupy about 20 per cent of the total area of the tanks. Smaller vents are liable to give trouble thru insufficient provision for handling floating matters and thru irregular release of gases. On the other hand, much larger vents and extensions of the vents for several feet above the flow line in the tanks do not entirely stop foaming over into the flowing-thru compartment or irregular release of gases.

Lower Compartment. The percentage of water in the deposited sludge is apt to be very much higher than was formerly anticipated. It is not safe to figure on less than 90 per cent and in the case of tanks at Plainfield, N. J., and York, Pa., dealing with the flow of separate sewers, the water content has frequently been found to range from 93 to 96 and average about 94 per cent. This means that the sludge chambers should be much larger than originally figured when based on about 85 per cent water content.

In the Northern States where sludge is not removed during the severe winter season the sludge storage on a per capita basis should range from 1.7 to 2 cubic feet per capita. Even this does not provide from more than about six months' storage of the sludge on an average, as against a nine months' storage period which may be desirable for some localities. On the other hand, in southern climates where sludge may be removed frequently during the winter months the sludge storage may be made somewhat smaller.

In recent instructions, issued by the Minnesota State Board of Health, it is specified that the sludge capacity shall be at least 2 cubic feet per capita, with a plant handling sanitary sewage; and 50 per cent more than this for tanks handling the flow from combined sewers. It is furthermore stated that this capacity should be figured from a plane 2 feet below the slots and above a surface at an angle 30 degrees from the horizontal and beginning at a point 8 inches below and directly under the lower edge of the sludge removal pipe.

A recent design for Fort Worth, Texas, provides for 1.21 cubic feet per capita of sludge-storage space which is considered sufficient with sanitary sewers for the climatic conditions there prevailing.

Tank Covers. For control of odors buildings over Imhoff Tanks have often been considered, altho, with perhaps the exception of a plant at Austin, Texas, none have been built.

Reversed Flow. At Huntington, L. I., where the effluent from Imhoff Tanks discharges into the harbor, the plant operator has changed the connections at the ends of the tanks so that the sewage may enter the gas vents at a velocity sufficient to move along for a considerable distance from the inlet end. Then the sewage moving downward is mixed with the contents of the digestion chamber, with its contents of black sticky sulphide of iron, and rises up thru the slots and thence out thru the outlet end of the flowing-thru compartment. Within certain limits it is believed that this arrangement brings about additional clarification thru the coagulating effect of the gelatinous iron sulphide.

Sludge Beds. The original provision of 0.33 square foot per capita for area of sludge beds has been found to be much too small in northern climates, where little or no use may be made of the beds for 3 or 4 months during the colder season of the year and where frequent rainfall interferes with drying during the warmer months. In the Northeastern States the writer has found it advisable to provide 0.75 square foot per capita for plants dealing with sanitary sewage. In the case of combined sewers the sludge beds ought to be at least 1 square foot per capita. The latter limit is called for by the Minnesota State Board of Health.

Separate Sludge Digestion Tanks

Experience in this country with digestion of sewage sludge removed from sedimentation tanks to independent tanks devoted exclusively to the digestion of the sludge is somewhat limited.

Extensive use, however, has been made of separate sludge digestion tanks at Baltimore in connection with hydrolytic or single-story sedimentation tanks in which the sludge is more or less digested prior to removal. In 1914 these separate sludge digestion tanks consisted of 3 square tanks and 16 circular tanks with a combined volume of 939,000 cubic feet. At that date the average sewage flow was approximately 23 million gallons daily of an average strength approximating 100 gallons per capita. For a time these tanks worked well as regards sludge digestion but gradually become overtaxed during the war period. By 1920 the average daily flow was more than 52 million gallons and the construction of more digestion tanks was undertaken. When adequate tankage is available, it is stated by the Baltimore operators that the sludge digests well in separate tanks, but if the tankage is relatively small some of the sludge may reach the outlet in an undigested condition.

Single-Story Tanks Used in Rotation

About a dozen years ago an effort was made with the old single-story septic tanks at Plainfield, N. J., to operate the tanks in rotation. The sewage was allowed to flow thru one tank until the effluent contained objectionable quantities of suspended matter. Then this tank was put out of service and a second tank was placed in service until it also showed gas-lifted solids in the effluent. In this way three tanks were devoted to sludge digestion while one was receiving the sewage flow for sedimentation. The plant became overtaxed and did not serve the purpose satisfactorily altho there were substantial advantages in this style of operation as compared with the use of the tanks in parallel. The plants at Morristown, N. J. and at Washington, Pa., since their early days, have been operated in this manner and until the plants were overtaxed satisfactory results were obtained. Within certain limits these arrangements allow a separate digestion of sludge and of scum in the tanks where there is sufficient sewage to dilute the toxic products of decomposition, and if a tank is allowed to digest, as is the case in the lower compartment of two-story tanks, it is feasible to remove the sludge in a well digested condition.

Another advantage of this process is that it provides for tanks of a depth of not over 10 feet; preferably covered with a tight concrete cover, an important factor in preventing a dissemination of odors.

The removal of the digested sludge is not so convenient as with two-story tanks since it requires special labor and flushing from a hose, and also handling considerable septicized sewage found in the tank above the digested sludge.

This type of tanks should be built in 5 or more compartments with a total capacity of 18 to 24 hours of average daily sewage flow. They are much cheaper to instal than tanks of the two-story type, especially where quicksand or rock is encountered.

This is the type of tank recommended shortly before the Armistice for adoption for army camps. Limited funds among other reasons resulted in its recommendation recently for a large state hospital at Morris Plains, N. J. and also at El Paso, Texas, it is understood, because of quicksand at the most suitable available site.

Plain Sedimentation With Continuous Sludge Removal

At Syracuse, N. Y., extensive tests have been made with sedimentation tanks arranged with scrapers working along the bottom of the tanks from the outlet toward the inlet end. It was found that the velocities should not exceed about 1.75 ft. per minute and that the detention period need not be more than about three-quarters of an hour. Thus at Syracuse about 60 per cent of the suspended matter was removed, with comparatively little improvement resulting from a longer detention period or a lower velocity. Continuous removal of the sludge prevents the formation of gas and of gas-lifted floating sludge. Floating matters are retained by scum boards. Solids removed from the floor of the tank by the scrapers will be mixed with wastes from the Solvay Process Company.

At Indianapolis "concentrate thickener tanks" have been designed, 4 in number, 15 feet wide at the top and about 120 feet long. The floors of these tanks will be scraped by moving scrapers from the outlet toward the inlet end at a speed not to exceed 5 feet per minute. These tanks will receive the solids rejected by the screens, and their effluent may be sent to the river or pumped to the influent of the aerating tanks of the activated sludge process.[4] The sludge from the thickener tanks will be mixed with the settled sludge coming from the activated sludge process and the resulting mixture dewatered.

Contact Beds

Under ordinary conditions contact beds are not as economical as regards total cost as are trickling filters. However, for some institutional and small city plants, they have a distinct field of usefulness. For large institutions and residential towns they afford the advantage of not calling for as great isolation as trickling filters, in that they do not expose the sewage to view until after it has been rendered non-putrescible in beds to which clarified sewage is applied beneath the surface. Furthermore, the filling of the voids in the stone prevents trouble from flies.

In Ohio, where the tax laws make it important as will be explained beyond, to minimize operating expenses it has been found that in some instances the smaller head required for contact beds justifies the greater investment thru the elimination of the need for pumping with its attendant operating costs. Contact beds have been adopted at Marion and other places in Ohio.

In securing a non-putrescible effluent it apparently makes very little difference whether single or double contact beds are used as the loading per cubic foot of material seems to be the controlling factor. Where the effluent is to be discharged into a fairly small stream above the intake of a water supply there is considerable merit in using contact beds followed by sand beds as is done in numerous cases in New Jersey. If the stone in the contact bed is of a relatively large size it is prudent to provide a settling basin between the contact bed and the sand bed.

Trickling Filters

There are dozens of trickling filters which have been in successful service from 10 to 25 years in this country and England. Taken as a whole they have been as successful as, if not more so, in producing practical accomplishments, in line with what was earlier expected of them, than any single group of treatment devices in existence. Twenty to twenty-five years use has not caused need for cleaning English filters and records of a similar nature are available in this country with plants that have been in service a dozen or more years.

Aside from the general commendation as to their performance, trickling filters are worthy of note here in relation to three factors that are frequently discussed by sanitary engineers. They relate to the question of odor, plant loadings and control of flies which may be objectionable in the neighborhood.

Odor Control. Trickling filters will not produce objectionable odors, noticeable more than one to three hundred feet away, if they receive sewage which is not partially decomposed or septicized. "Nozzle odors" are to be found at some plants where decomposing sewage reaches them thru septic tanks or, in some extreme cases, where the sewage is in a stale and putrefying condition before it reaches the preliminary tanks. Bothersome conditions arise from foaming tanks, of the two story type, particularly when the tank effluent contains decomposed matters in substantial quantities either from overflowing gas vents or from the entrance of material from the lower into the upper compartment.

In connection with nozzle clogging it is to be pointed out that even where tanks are used, the use of screens to retain floating matter is sometimes highly desirable, as is evidenced at Baltimore and elsewhere. Furthermore, complete freedom from nozzle clogging is not possible, owing to the intermittent detachment of the accumulations of fine suspended particles which adhere to the inside of the influent distribution system to which the nozzles are attached.

Experience at Brockton, Mass., for some four or five years shows that nozzle clogging can be kept in reasonable control by the continuous use of fine screens. Similar results are recorded by Mr. Hammond at Brooklyn, N. Y., in his experience when operating for some months trickling filters receiving screened sewage.

Filter Loadings. Behavior of trickling filters in practice shows that for the ordinary 6 foot bed a two-million-gallon rate per acre is by no means excessive. This equals 3333 persons per acre foot with sewage of fairly normal strength, say 100 gallons per capita daily. Special tests made at Schenectady and experiences at some other plants where filters were overloaded indicate that a non-putrescible effluent may be obtained with rates in excess of these, say up to 4000 persons per acre foot. This is particularly true if the beds are made somewhat deeper than usual so as to guard against passage of some of the influent too quickly from top to bottom, and further providing that the spacing of the nozzles and the head upon the nozzles is such as to secure a distribution of sewage over the surface of the bed as uniform as practicable, and more uniform than is found at quite a number of plants now in operation.

In northern climates there is some falling off in nitrification of the effluent during winter months, altho this seldom cuts much figure as regards objectionable conditions in the body of the water into which the effluent after sedimentation is discharged. In southern climates on the other hand it is feasible to use filter loadings substantially greater than in the north and equal in some cases to fully 5000 persons per acre foot.

Filter Loadings with Unsettled Influent. The loadings above mentioned relate to sewage that is passed thru sedimentation tanks. When the latter are omitted and the sewage passed thru fine screens the removal of suspended and organic matters is much less and it is necessary to consider carefully what the adjustment in loading should be.

First it should be recalled that nozzle clogging is not a point at issue in this connection. Secondly, it should be recalled that screened sewage from the ordinary American city contains no more suspended matter than does the settled sewage of many European cities, or of some American cities in the southwest where 100 per cent meterage and other factors minimizing water consumption reduce the flow of sewage to from 60 to 75 gallons per capita daily.

There are two aspects to this filter-loading problem in reference to adjustment between requirements for settled as contrasted with a fine screened influent. One factor is the suspended matter and the other is the organic matter. Tanks usually remove from 50 to 60 per cent more suspended matter than do fine screens and perhaps as much as 30 per cent of the total organic matter.

A further element to be considered is the result of experience accumulated in England by the Royal Commission as a result of its investigations for more than a dozen years. There investigations are summed up on page 65, Appendix IV, Fifth Report, 1910, with the conclusion, expressed in American terms, as follows:

> This experiment, therefore, supplements experiments I and II in showing that a trickling filter of coarse material 6 feet deep can treat a septic effluent of more than average strength and containing about 200 parts per million of suspended matter at a rate of 150 U. S. gallons per cubic yard per 24 hours, or an effluent of half that strength with 100 parts per million of suspended matter at the rate of 300 U. S. gallons, giving in both cases practically the same purification of organic matter and producing a good well oxidized effluent (apart from suspended solids).

Taking the strength of sewage as 150 parts per million, it is seen that this would allow, according to the Royal Commission findings, a rate of 200 United States gallons per cubic yard, equal to 3250 persons per acre foot with an ordinary sewage flow of 100 gallons per capita daily or equal to a loading of 26,000 persons per acre for an 8-foot bed.

At Lima, Ohio, with combined sewers, a recent design for trickling filters, preceded by fine screens alone, provided 3.6 acres of trickling filters 8 feet deep to treat an estimated average daily sewage flow of six million gallons from a population of 60,000 people. This is equal to a loading of about 200,000 gallons or 2,000 persons per acre foot.

The suspended matter in the screened influent at Lima is estimated at 175 parts per million, which at the Royal Commission rating would permit a loading of 275,000 gallons or 2750 persons per acre foot.

Fly Control. On the surface and in the upper layers of trickling filters there is sometimes, but not always, found a small fly which accumulates at intervals in enormous numbers and which may be windblown for some distances from the filters so as to prove an annoying feature if not controlled. Dr. Thomas J. Headlee, State Entomologist of New Jersey, investigated this question at the Plainfield plant with the results as stated in the Journal of Economic Entomology, February, 1919, page 35. He found these filter flies to be principally "Pscyhoda Alternata" which grow in the films surrounding the filter stone. His investigations showed that the larvae and pupae breathe atmospheric air and if deprived of it for 24 hours they are destroyed. Flooding the filters at intervals of 10 days eliminates the fly growth because it takes two weeks for the flies to reach the adult stage. It is not possible, however, to eliminate thus the development of eggs which apparently will resist the effects of submergence.

By making trickling filters in compartments which can be flooded in rotation for 24 hours once in 10 days it is possible to keep the fly situation under control and to do so without materially disturbing the biological efficiency of the filter bed.

In all recent designs the writer has provided for this feature of submergence altho at many trickling filters flies have not proved bothersome.

Activated Sludge Process

It is scarcely necessary to go into much detail as to the nature of this process concerning which much helpful data have been set forth in the Proceedings of this Society thru the generosity of Mr. Hatton of Milwaukee; Mr. McVea of Houston and Mr. Hammond of Brooklyn. It is particularly fitting to refer to the operating results from these and other places, not forgetting the city of Cleveland with its extensive tests conducted during 1916–17, and special reference should be made to the Houston data of which an excellent summary appears in Engineering News-Record of July 27, 1922.

Performances. Operating experiences show that by no means should there be misgiving as to the ability of this process to turn out regularly a clear, non-putrescible effluent from which 90 to 98 per cent of the bacteria in the raw sewage have been eliminated. Whatever may be said as to the practicability of the process relates not to the quality of effluent but to economies of the sludge-handling proposition in particular, and in general to the constructing and operating cost of the process in comparison with trickling filters. Comparative data will naturally vary in different places.

Adoption. It is worthy of note that within the past year a plant of this type has been put in service at Gastonia, N. C.; the Maywood plant at Chicago is practically complete after long delays in construction; Milwaukee is constructing its aeration and sedimentation tanks; the process has been recommended and designs are being prepared for a plant to serve about 800,000 people in the northern portion of the Chicago Sanitary District; and this process has also been recommended for adoption for portions of the sewage flow of Los Angeles. Smaller plants are also being designed and built at a number of places.

Sludge Handling

This problem furnishes a live topic for discussion with experiences varying from time to time depending upon the state of the art as developed through various devices. The problem obviously is not now in the same light as it was during the war on account of the subsequent drop in the fertilizer market and the inability at the present time to dispose of dry sludge under any ordinary conditions at a figure approaching the cost of dewatering.

Hence, if the advantages of this process as regards freedom from odor and ability to produce a satisfactory effluent are to be availed of, it must, for the present, be adopted in connection with methods which will minimize the cost of sludge handling until such time as the market value of the dry sludge will equal the cost of dewatering. Of course there are exceptions to this rule where some of the simpler methods of sludge removal are not applicable and where at least partial drying is necessary.

There are even cases where the local demand for fertilizer may make it worth while to take unusual steps for delivery of either wet or dry sludge to the farmers in the general locality.

Lagoons. To one who has not visited the Houston plants it is remarkable that activated sludge can be delivered from settling tanks into lagoons and there allowed to accumulate year after year without producing nuisance. And yet that is a fact as recorded by the city officials of Houston and by every engineer so far as the writer knows who has ever visited Houston.

For the North Side problem in Chicago a Board of Engineers consisting of Messrs. Eddy, Hatton and the writer recommended the adoption of the activated sludge process, with a delivery of the wet sludge thru a pipe line to the waste lands between the Des-Plaines River levee and the main drainage channel. The sludge is to be lagooned there until such time as the cost of drying operations will not exceed the proceeds to be derived from the sale of sludge as a fertilizer. This is a suitable local solution of a difficult problem for a certain period during which it is expected there will be substantial advancement in the art of sludge handling.

Sludge lagooning is of course not universally applicable and conditions such as exist at Chicago and at the South-Side plant in Houston are by no means to be generally found. At the North-Side plant in Houston difficulty in finding adequate suitable land for a term of years has already led the city to consider carefully various means of sludge dewatering.

Maclachlan Process. Much promise now attaches to this process which is primarily a conditioning treatment of sludge with sulphur-dioxide fumes which destroys the gelatinous character of the sludge floc leaving a fibrous and somewhat stringy solid mass capable of settling readily. This gassing results in a coagulating effect plus a partial sterilization of the sludge which tends to eliminate odor and decomposition.

It is claimed that the Maclachlan process prepares the sludge so that it may be either dried on sludge beds at the rate of about 1.3 pounds of dry solids per square foot of bed per 24 hours as at Gastonia, N. C., or it may be passed thru a cylindrical inward flow drum screen covered with 60-mesh brass wire cloth revolving about two-thirds submerged in a vat thru which the gas-treated sludge is fed continuously. The free water passes thru the screen and the sludge builds up a filtering sheet which holds back the finer particles. As the screen emerges from the water this sludge is picked up on a traveling felt belt similar to the "wet machine" used in the paper industry. After being picked up on the belt it is passed thru squeezing rollers where some of the water is pressed out and it is then discharged from the belt in a thin sheet with a water content of about 80 per cent This process has been tested at Houston beginning about the first of July and is said to produce a sludge cake of the water content above mentioned at a cost of from $5 to $7 per ton of dry solids.

Sludge Drying. The limits of this paper do not permit of a description of the Oliver filter or sludge presses of various types which have been under investigation and which will doubtless receive further attention at Milwaukee and at the Maywood plant in Chicago before final conclusions are drawn.

As regards the drying of the sludge cake to the 10 per cent moisture required by the fertilizer trade, it is sufficient here to say that there is no reason to believe that this problem cannot be kept under reasonable control. Experiences in dealing with other odor-producing substances however show that dryers of ample proportions must be used and that adequate arrangements must be availed of constantly for the elimination of odors as well as dust by means of combustion chambers, dust catchers, spray jets and the like.

Fortunately data are now being accumulated at a number of places so that there is reason to believe that there will be opportunity to place activated sludge on the market commercially as soon as the economic conditions warrant.

Final Tanks

In all oxidizing processes other than sand beds there is need of settling the effluent, whether it be obtained from trickling filters, the activated sludge process, or the "direct oxidation" process. There is now a well defined tendency shown in various places to remove the sludge from such settling tanks at fairly frequent intervals, if not continuously, by the aid of Dorr thickeners, which facilitate the delivery of the deposit on the floor of the tank to a sump.

Electrolytic or Direct Oxidation Process

The use of electricity as a purifying agent has appealed and continues to appeal fascinatingly to the lay mind. For more than 30 years arrangements in which use is made of electricity have come up for consideration. The writer first became acquainted with the so-called "Webster process" of this type in London in 1890. In test plants this process was shown to be to a considerable extent a coagulating arrangement whereby electricity was used to decompose iron or aluminum electrodes, thus forming hydrates of these metals. The effective work was chiefly done in a manner more or less resembling the coagulating effect in water treatment plants in which use is made of sulphates of iron or alumina.

Undoubtedly there is some electrolytic decomposition of water even where iron and aluminum plates are used and bubbles of oxygen and hydrogen are released. Some of the oxygen is released in an atomic or anodic state whereby it has a high power for oxidizing even inert organic matter. Excessive cost has kept this process from general adoption.

Harris Process. The writer investigated electrolytic arrangements of this sort at Louisville at considerable length in 1897, but they did not offer reasonable prospects for practical success. The arrangements tested at Louisville were known as the "Harris magneto-electric process." Plants of this type were installed for sewage treatment at Santa Monica, Cal., Oklahoma City, and a few other places. But practical accomplishments have been small and all of the plants have been abandoned except the one at Santa Monica which was found a year ago to be still in service under conditions greatly overtaxing its limits of effective performance.

Recent Developments. During the past 10 years or so much attention has been given to improved arrangements, made largely thru the efforts of the Landreth Company of Philadelphia, by the introduction of revolving paddles between the electrodes to remove the gases which cause polarization. Use was made of lime, presumably at the outset to increase conductivity and to lessen the quantity of electricity used per unit area of electrode.

The "Landreth electrolytic process" was installed some 8 years ago at Elmhurst in the Boro of Queens, New York City. It was investigated at length by the city officials of New York, preparatory to deciding whether to adopt the process for other plants within the city limits, but no such plants have been installed.

At Decatur, Ill., extensive investigations were undertaken shortly thereafter, but the process was not adopted and after a delay of some 5 or 6 years trickling filters are now being installed there.

Clark Process. The "Clark process" of the electrolytic type was devised and patented by J. M. Clark some 6 or 8 years ago when it received some attention in New Jersey. The successor to this process is known as the "Selo method" which is somewhat similar to the "Landreth electrolytic process" except that in the "Selo method" there is separate treatment of the sludge to which salt is added and there are certain differences in plant details. By this method the sewage is dosed with milk of lime in an agitating tank, then settled in a circular tank having a Dorr thickener and passed thru an electrolyzer. The sludge is mixed with a solution of salt and electrolyzed, disinfected and deodorized by the sodium hypochlorite which is formed by the use of electricity. It is claimed that the sludge is rendered drainable to 60 per cent moisture in 48 hours so that it may be used as a fertilizer.

A plant of the "Selo method" was installed several years ago by the Thermoid Rubber Company at Trenton, N. J. It is understood that the electrolytic features of this plant added little or nothing to the quality of sewage effluent and it was found on a recent visit there that the electrolyzers had been removed.

Direct Oxidation Process. The Landreth patents covering the so-called "Direct oxidation process" have been controlled by the Municipal Sewage Disposal Company of Philadelphia, which has installed two plants, one at Phillipsburg, N. J., and another at Allentown, Pa. At Phillipsburg the plant has been in service for about 2 years and last spring an extensive set of tests was made by the State Department of Health but the results have not yet been made public. At Allentown a 3-million-gallon plant at a cost of about $180,000 was installed and has been in intermittent service for nearly a year. Sanitary sewers in Allentown have been built only to a limited extent and it is understood that at present there are only about 700 sewer connections which produce a volume of flow which permits the treatment plant to be operated only a few hours each day.

At Easton, Pa., a test plant was installed in 1919 for demonstrating the practicability of the improved devices of Mr. Landreth, in which use is made of both electricity and lime, followed by sedimentation. This test plant was studied by several engineers and chemists of Philadelphia with results as stated in a paper presented to the Franklin Institute in 1919. The Easton plant was also investigated by the Pennsylvania State Department of Health with results as summarized in Engineering News-Record of September, 1919, page 569.

As the "Direct oxidation process" now stands, it may be fairly stated that it has received widespread attention and that the merits of the process have come into sharp controversy. This means that adequate data for giving the process a true rating are seemingly lacking, at least to the extent of being persuasive to the minds of many. Briefly, the opponents claim this process to be no more efficient than if lime alone is used; that the process is unreasonably expensive to operate, especially where the sewage contains a very high amount of hardness requiring a large dose of lime; that the effluent, while very well clarified due to coagulating effect of magnesium hydrate, is not purified of its organic matter to a degree sufficient to serve the local requirements at many places; and that the destruction of bacteria by the process is not due to the action of electricity but on the contrary to the excess of caustic lime in the effluent which ranges from 30 to 80 parts per million.

On the other hand, the proponents of the "Direct oxidation process" claim that it is cheaper to install than plants of the biological type; that it permits an attractive looking and inoffensive plant to be located within built up portions of the city; and that it allows the sludge to be handled in an inoffensive condition and dried so as to produce a product that is marketable.

It is not the purpose of this paper to go into great technical detail but rather to outline some of the main comparative features of the so-called "Direct oxidation process" and of so-called "Biological processes" as they have come into competition at Lima, Ohio. Controversial aspects of the local sewage problem as it now stands at Lima have produced a deadlock for the present year, leading to a series of claims and counter claims which are of some interest and perhaps of value as a warning guide.

Sewage Treatment Situation at Lima, Ohio

Lima is a city of about 45,000 population with several large manufacturing plants and a growing population outside the present city limits. It is located on the Ottawa river, having a drainage area of about 100 square miles. The flow of this stream, which passes thru the heart of the city, becomes almost nominal during summer and is lessened by storage reservoirs above the city into which water is pumped from the river during periods when there is a substantial flow. The result is that the stream bed is practically an open sewer from which offensive odors emanate for a distance of several hundred yards on either side.

Due to the complaints of riparian owners below, the State Department of Health under the terms of the Bense Act ordered the city to purify its sewage. Fuller & McClintock made a report in 1916 on relief sewers, intercepting sewers and treatment works, recommending the adoption of the activated sludge method. But little was done during the war period and beginning in 1919 construction work related largely to relief sewers to improve conditions in the built-up part of the city where the original combined sewers proved inadequate.

In 1921, Fuller & McClintock were engaged to design intercepting sewers and treatment works. After considering the problem in detail they recommended the adoption of fine screens followed by trickling filters and final settling tanks equipped with Dorr thickeners. This decision, differing from the preliminary report of 1916, was made partly because of inability, with the activated sludge process, to treat the sludge in a way to yield any proceeds from its sale, but chiefly because under the Ohio law it is highly desirable, if not essential, to keep the operating expenses of sewage treatment plants at a minimum.

Under the terms of the amended Bense Act the interest charges on bond issues required for the construction of sewage treatment works when ordered by the State Department of Health to correct a nuisance, are not required to be paid from the general fund raised by taxation, to which there is a maximum limit of 15 mills per dollar of assessed valuation.

Operating expenses for treatment works on the other hand must be paid out of funds raised by taxation and must be kept within the 10-mill rate unless there is a special election to authorize, by vote of the people, a special tax above this limit; but in any event a limit of 15 mills cannot be exceeded.

Plans and specifications for the fine screens and trickling filters were completed and approved by the State Department of Health, subject to the provision that preliminary sedimentation would be required if found necessary. A letting was authorized with bids to be received on April 1, 1922. About a week prior to this date, the Municipal Disposal Company of Philadelphia persuaded the City Commission at Lima to postpone the date of the letting and to take steps towards receiving alternate bids for a plant of the Landreth "direct oxidation" type. Plans and specifications for the latter were prepared and submitted to the State Health Department for approval. Specific data on the cost, method and adequacy of performance of the "Direct oxidation process" have been requested of the city officials by the State Department, and Col. George A. Johnson has been retained by the city to obtain information in respect thereto.

Several months have elapsed during which the merits and demerits of the trickling filter method (Contract A) and of the "Direct oxidation process" (Contract A-II) have been debated pro and con by the various parties in interest. Briefly, the situation may be summed up as follows:

1. The installation cost of pumping station and treatment works by the trickling filter method, with its established record of adequacy and successful performance for a quarter of a century, was estimated in December, 1921, at $691,000 as compared with a sum said to be about $400,000 for the proprietary arrangement with a number of novel features not yet worked out on a practical scale on a sizable plant.

2. The annual operating cost of the trickling filter method, including all pumping, fine-screen operation and sludge disposal from final settling tank, is estimated to range from $13,000 to $15,000 in comparison with which is an estimated sum of $40,000 for the "Direct oxidation" process. In this latter process it will be necessary to use, according to tests at Lima, about 2800 pounds of lime per million gallons and about 150 kw.-hr. per million gallons for electrolyzers, in addition to the costs of pumping and screen operation, attendants for pumps, fine screens, electrolyzers, Dorr tanks, and sludge drying plant (3 tons dry basis per million gallons) of the vacuum filter type. These estimates in each case are for fine screens operating at the rate of 4 million gallons daily for 12 months per year and secondary treatment for the 7 warmer months. As the quantity of sewage increases later the financial disadvantage of the "direct oxidation" process will increase.

3. As to quality of effluent, the trickling filter plant will produce an adequately clarified and non-putrescible effluent, suitable for discharge into the Ottawa River. As regards clarification, the "direct oxidation" process, when an adequate dose of lime is applied, will produce the same result. But as to the removal of dissolved organic matter the evidence indicates that the "direct oxidation" process is no more efficient than "excess lime treatment" alone and that dissolved organic matter is not removed with substantial completeness but is simply left undisturbed in a sterile effluent so long as sufficient caustic alkalinity remains.

4. The "excess lime treatment" for sewage is not a novelty but was employed at London more than 30 years ago and was abandoned on account of the secondary putrefying reactions which took place with the organic matter on the bottom and sides of the River Thames.

In presenting the above paper Mr. Fuller gave a recapitulation of it together with the following comments:

This paper outlines some of the high places. It is not my purpose to go into any great technical detail. Perhaps most interest attaches to the closing pages, dealing with the problem at Lima, Ohio, and the direct oxidation or electrolytic process. That process has been up for consideration for a whole generation in one form or another. I realize that there have been improvements to the process and that the process as applied at Allentown is not exactly what is used at Phillipsburg. There have been advances, no doubt.

There may be situations where that process is applicable, but when it is applied to a situation like that at Lima, Ohio, I do not feel that such is the case. The city has called in Colonel Johnson, a member of this Society, to advise in reference to the local controversy. He has recommended that this process of direct oxidation be adopted. His report is now public and he says this: "The evidence now at hand gives clear promise that this process, direct oxidation, more than any other developed on a practical scale, can satisfactorily solve the Lima problem continuously, reliably and economically."

How far that process depends for its accomplishments upon the use of lime, I will not attempt to say. Those of you who are familiar with the Columbus plant for water softening know about the bactericidal effect of excess lime and also the powerful coagulating and clarifying effect of magnesium hydrate which must be formed in hard water or hard sewages.

I want to point out that this process (direct oxidation) for 60,000 people is estimated by Colonel Johnson to cost about $500,000 and the annual operating expense will be $58,000, for treating 6,000,000 gallons daily 12 months per year, whereas for trickling filters the investment was estimated by my firm, Fuller and McClintock, at $691,000 and annual operating expense of from $13,000 to $15,000, for clarifying 4,000,000 gallons daily 12 months per year and filtering this quantity for the seven dry months. Colonel Johnson is very strong on the proposition of operating the full plant every day in the year, whereas we recommend that the fine screens will adequately take out the visible sewage matters during the five colder months of the year and that the seven other months are sufficient for the operation of the trickling filter, and the pumps which they require.

The city of Lima is not in a position to take care of these added burdens of cost within the one percent Smith Act unless they have a special election to authorize an increase in taxes to meet the costs of operating the sewage plant. In a city which does not now provide all the city service it ought to provide, and where it is proposed that the city carry this added burden of operating expense for a sewage treatment plant, it seems to me we are going to hear a good deal, and properly so, from the viewpoint of the citizen, about the merits of this recommended process and the costs which go with it.

I have nothing to say against the Allentown plant, I am not here to throw mud at it or any other plant of its type, but I do want to point out that a really serious situation has developed as to how these pressing sewage disposal problems under circumstances such as have developed at Lima can be solved in a reasonable way. I don't believe myself, as the result of my experience and observation both here and abroad, that great progress toward ideal sewage treatment can be made by putting the blunt end of a wedge to the front first. I am for the thin edge of the wedge first. Enough is sufficient; so why put cities to needless expense?

I am of the opinion that there is an inadequacy of data supporting this direct oxidation process for a place like Lima, where it will take about 2800 pounds of lime per million gallons to produce the excess causticity which they need with the electrolytic treatment and where there will be over three tons of dry solid sludge per million gallons. It seems to me best to look pretty cautiously and carefully into the supporting data before adopting such a proposition. Such plants elsewhere are not running continuously under conditions such as exist at Lima for summer conditions. At least, it seems to me, we have got to stop, look and listen.

Further discussion of this paper will be found on page 191.

SEWAGE PURIFICATION BY MEANS OF THE SELO METHOD

By Louis E. Gelinas, President of Gelinas Engineering Co., New York City

What is the Selo method and how does it operate? As commonly known, sewage is water that has been polluted and defiled by animal and human excreta, kitchen refuse and factory wastes, from a thousand different sources, all fairly alive with germ food and germs that multiply very rapidly, deadly disease germs such as typhoid and occasionally cholera, besides others less harmful in character.

This sewage enters the plant and first goes into a grit or screen chamber in order to remove sticks, stones, etc. Next it enters a weir box where the flow is measured. To this is attached an automatic arrangement that practically runs the entire plant, adding more or less milk of lime and current, depending upon the flow. From here it enters an agitating chamber where the milk of lime is added and agitated with the sewage. The idea of adding lime to sewage is an old one, its purpose being to precipitate the solid matter. The methods of applying it however have been different. It has always been added by agitating the sewage by means of baffling while the Selo method does it by its own means of churning. The idea of churning is not a novel one. It has been used in ice-cream freezers, washing machines, etc. The sewage then enters the decantation tank under its own head, where the flocculation occurs, the solid matter being precipitated to the bottom. The sewage enters this tank at the center below the surface, the effluent overflowing the inner rim of the circular launder from which it is led by a pipe to the effluent electrolyzer. The only principle involved here is that matter heavier than water goes to the bottom. The flocculation merely hastens the precipitation of the solid matter.

In sewage we know that organic matter is held in two ways; suspension (human excreta, etc.) and solution (urine and dissolved food stuffs). It is hoped in this decantation tank to precipitate the suspended matter, but that which is in solution still remains.

Therefore the effluent is run thru the electrolyzer for a light treatment. This is a cell made up of graphite plates. The current being turned on breaks up water (H_2O) and evolves oxygen. The oxygen that is evolved is atomic or nascent oxygen. It is a chemical law that oxygen in this state cannot possible exist in the presence of oxidizable matter. Therefore it is bound by law to oxidize everything. The amount of current is regulated by the degree of purification desired. The attitude of the writer is that inasmuch as it takes very little current to do this, one should produce as high a degree of purification as practical. Why do it only part way, when one can render so much better at very little expense. One way is positively certain while the other is not. A question may arise, is oxygen actually evolved? Oxygen has been made commercially for years this way but besides, the Engineers Manual shows that from 1 ampere hour of current .2983 grams of oxygen is evolved, so there can be no question as to that.

The sewage is drawn into another electrolyzer where cheap salt (sodium chloride) is added. When current is applied the salt is broken up, forming caustic soda at one plate and free chlorine at the other. By means of a little compressed air, a very active germicide (sodium hypochlorite) is formed. This germicide is ten times stronger than pure carbolic acid but at the same time is not a poison. This is proven by the General Laboratories Company, Madison, Wis., and Bethlehem Laboratory Company, Bethlehem, Pa. The organic matter of the sludge is oxidized and after an hour's treatment is rendered absolutely sterile and non-putrescible, free from any offensive odors; besides, its cellular construction is such as it will drain and dry rapidly. There is nothing in its entire operation that is complicated and nothing that cannot be proven. It is an association of tried and established principles but never before applied to sewage treatment.

The question of the quantities to be used naturally depends upon the strength of the sewage to be treated. The following however is submitted as the maximum to be used per M gallons. Seven-eighths of a ton of cheap grade lime; 400 lb. of cheap grade salt (1 oz. to the gallon of sludge), just as it comes from the mines. It will take about 184 kw.-hr. of current to treat the effluent and sludge besides running the plant automatically per M. gallons.

The Selo method offers as it were a sort of manufacturing plant, the different elements used according to the kind of sewage treated rendering a certain degree of purity at a fixed cost. The space required for the plant is relatively so small as to enable comparatively inexpensive housing so that climate is no bar to operation.

Another feature pertaining to the Selo method is that it can be built of any size, accommodating any flow, besides being built in any location. One never need fear offensive odors as it is impossible to get them, thereby giving the extra advantage of building anywhere, doing away oftentimes with the added expense of constructing extra trunk systems to bring the sewage out of the city limits. The sludge will never harbor flies or insects as the chlorine is repellant. This means the doing away with breeding grounds for them. Although the sludge question has not been given very much attention by the State Boards of Health, inasmuch as they are chiefly interested in the stream pollution and consider the sludge a problem for the community to solve, nevertheless the writer thinks it should receive their earnest consideration, inasmuch as the untreated sludge makes, as said before, ideal breeding grounds for flies and insects. This increases another agency by which diseases are spread.

The statement has been made that the Selo method is similar to other electrolytic methods, but such is not a fact. It differs in construction, principle and system of operation.

All other methods of sewage purification by means of electric current treat sewage as a whole, while the Selo method separates the effluent and sludge and treats each as it requires. In a million gallons of sewage there would be approximately 5,000 gallons of sludge or about 0.5 percent. It is this solid matter that has caused the greatest amount of trouble and needs a very intensive treatment. According to the Selo method the rate necessary to properly oxidize the sludge is only applied to it while the others naturally have to apply it to the million gallons. This is a large economic saving.

The Selo patentees discovered that iron plate electrodes took up electricity forming useless iron-oxide. There is an electrochemical law that states if current is passed from one iron plate to another in water, oxygen is evolved at the opposite plate and forms iron-oxide. Oxygen going into that form naturally is lost for the purpose of oxidizing organic matter, the function that it is supposed to fulfill. The inventors substituted graphite long-life electrodes, which gave to the sewage all the oxygen developed, thus saving largely of current and producing more effective results.

Another important difference is the doing away in the Selo process of all moving and mechanical parts, such as revolving paddles, etc., essential to prevention of clogging and keeping the plates clean.

Let us now consider the Selo method in comparison with the other bacteriological digestive methods. The sewage enters both alike. With the bacteriological methods the sewage is retained for a certain length of time in order that the solid matter will go to the bottom. The Selo method does the same thing except that it goes one step further and that is, it adds lime as a coagulant to hurry nature's own method of gravity along. The other methods leave the sludge at the bottom for it to ferment and digest, the theory being one bacterium eating up the others, etc. This fermentation causes the liberation of a great deal of gas which is very obnoxious besides being explosive unless properly safe-guarded. After a while the sludge is drawn off to separate sludge beds for drying, which takes a considerable length of time. Sometimes the fermentation has been such that the sludge is removed very often to separate sludge digestive chambers for further digestion. Here oxidation takes place again but in the meantime gases are still formed. In either case the organic matter makes ideal breeding grounds for flies and insects. An example of this will be found at Baltimore, Md. With the Selo method the sludge is drawn off daily and is made absolutely sterile and inoffensive immediately by means of the electrolyzer, thereby preventing any nuisance whatsoever

The effluent from other methods is run through sand, rock, or sprinkling filters, or the combination of them all for the one only purpose of bringing every drop into contact with the air in order that the oxygen of the air will oxidize the organic matter that it contains. Bear in mind however, to do this properly requires large areas of ground. Besides, the oxygen depended upon for oxidation is molecular. This oxygen is slow to act being combined with other gases as well as its availability varying daily. Probably it is for these reasons that the results have been more or less uncertain so that some Sanitary Engineers realizing this are now recommending a further dose of liquid chlorine. Liquid chlorine in itself according to chemistry does no good in this work but it does evolve oxygen that does do the work. Sanitary engineers all recognize the fact that oxidization is the means to employ to eliminate the trouble and purify the effluent.

The Selo method recognizes the fact also but instead of depending upon the methods of oxidation just described, the effluent is run through a simple electrolyzer where a known quantity of very active oxygen (nascent) is evolved, the quantity determined by the amount of current used, thereby generating a positive weapon (oxygen) under its own control to do the work.

Any sewage purification question no matter how difficult or complicated can be solved in this way.

In the preceding discussion the writer tried to show just what the Selo method is and what it is capable of doing. When the claim is made that the Selo method is expected to remove from 98–99 percent of suspended matter; carry about 60 percent saturation in dissolved oxygen; a bacterial reduction of 99.9 percent; a 14-day stability for the effluent; and a non-putrescible, inoffensive and easily handled sludge, it means that the same can be accomplished.

GENERAL REVIEW OF ONE YEAR OF SUCCESSFUL OPERATION OF THE DIRECT OXIDATION PROCESS OF SEWAGE DISPOSAL AT ALLENTOWN, PENNSYLVANIA

H. F. Bascom, City Engineer

(*Mr. Bascom prefaced his paper by some remarks abstracted below, and the description of a number of slides showing views of the plant, part of which are shown in the cuts accompanying the paper.*)

Last evening, Director Henry Turner Bailey of the Cleveland School of Art, when delivering his wonderfully entertaining address mentioned the fact that he hoped he could convince at least three persons in the banquet hall of certain things. He surely must have accomplished his purpose. Dean Bailey showed you many slides of various locations in this country and then showed you "something different." He showed you pictures of the products of minds, principally, of other countries.

From this day we should consider it a pleasure and a duty to furnish Dean Bailey, as substitutes for the foreign views, similar views taken in our own U. S. A. I will furnish him a picture of a boulevard lighting standard with flower bowl for flowers and vines during the summer season, and for evergreens during the winter season, something different, which has been installed in our city for several years past.

During the early part of 1918 in looking over the rather broad fields of sewage disposal we visited an experimental station at Easton, Pa. It was something different than the others and we sincerely believed that our city needed something different from the processes or systems installed in or recommended at that time for other cities.

For several months we were constructing the plant and now since July 1921, some fourteen months, the plant has been operating. Today, I have brought as much of the plant along with me as was possible and am going to show it to you first then read about it afterwards.

Many of the sanitary engineers of this, and other countries, have visited the plant, some have been favorably impressed, a few others not so well convinced.

Some of our technical papers have taken a favorable attitude, others have expressed a somewhat different feeling thru their columns but this may have been due to lack of knowledge or absence of facts in their libraries. This process is not a cure-all for all localities, but we believe that it fits our conditions and possibly your city may have similar circumstances to meet. All we ask is that you look and listen, criticise if you will, but be fair.

In the collection of sludge from various plants and processes in an adjoining room it is noticeable that every one of the samples is bottled, possibly on account of the odors. I am pleased to present to the city of Cleveland to add to this collection a sample of the sludge from our plant at Allentown which needs no container.

(*Mr. Bascom presented the city of Cleveland with a small statue of Washington made of the sludge from the plant.*)

The city of Allentown, with a population of approximately 90,000, is located on the Lehigh River at a point approximately 18 miles above its confluence with the Delaware River, 92 miles west of New York City and 62 miles northwest of Philadelphia. The city is located on a limestone formation, well elevated, consequently well drained, and in the greater part of the city the sub-surface formation, consisting principally of limestone is of such a loose and open character as to readily accommodate such household wastes as are emptied into the cess pools or "sink holes" as they are called locally.

Until about 1900 no concern was given to the existing conditions, but with the rapid development of the city, various difficulties were encountered in disposing of the house sewage by the use of the cess pools, and in many instances connections were made to the existing storm-water sewers, because of the lack of other facilities.

Commencing in 1902 various investigations were conducted, consulting engineers were engaged and in 1908 plans were prepared and approved and permit issued by the State Department of Health for tanks and sprinkling filters at an estimated cost of $987,000.

This plan did not meet the approval of the electors and was rejected February 16, 1909. In 1914 new plans were prepared, a new site of 462 acres was purchased for $120,000.00 and a second permit was granted by the State Department of Health April 18, 1917. Because of its close proximity to the city of Bethlehem, which derives its water supply from the Lehigh River, these plans were also rejected and the tract sold in 1920 for $140,000.00 to the Lehigh Valley Railroad Company.

Early in February, 1918, under the writer's supervision the city thru its engineering department and with the coöperation of the city laboratories under the direction of Dr. H. J. Krum conducted an investigation of the direct-oxidation process which was being demonstrated at Easton, Pa. A few days later the later the Franklin Institute also conducted a test upon the demonstrating plant.

As a result of the conclusive data obtained from both these investigations, together with the complete absence of nuisance and the small area required, and because of the extreme purity of the effluent necessary to protect the water supply of Bethlehem immediately adjoining, plans and specifications were prepared and approved by the State Department of Health October 1, 1919, for the construction of a sewage treatment works embodying the direct-oxidation process, "or its equivalent," at an estimated cost of approximately $200,000, which included sedimentation basins and sludge beds.

Description of Plant

The disposal plant is located on Lawrence Street not more than 700 feet west of the 8th Street bridge, covers an area of 0.57 acres and serves sewage districts Nos. 1, 2 and 14 from which a flow of 1,910,000 gallons per day of sewage, uncontaminated with trade wastes, will ultimately be obtained, giving a maximum daily flow of 3,800,000 gallons.

Screen Room

The sewage enters the building from the street mains, then to the intake channel, then thru either of two shear gates, over an inclined screen 8′ x 8′ with openings of ¼″ diameter. The solids larger than the ¼″ opening, are retained on the screen and are brushed by five revolving brushes supported on an adjustable

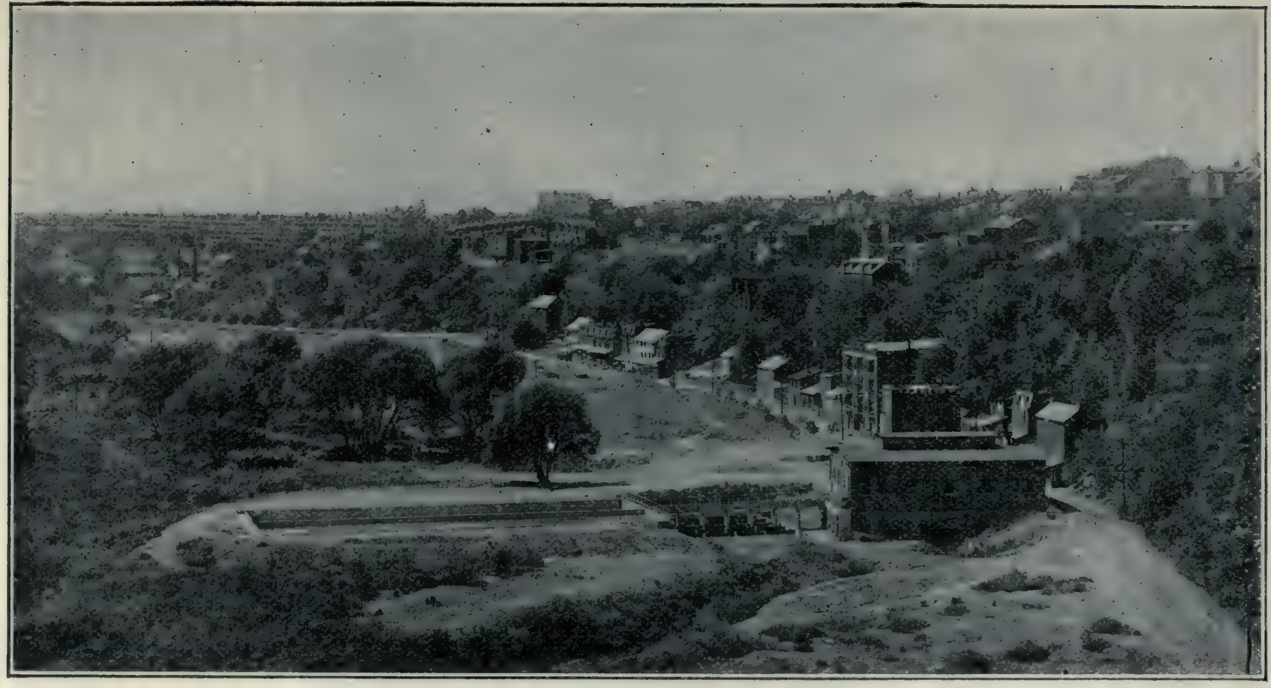

FIG. 1. VIEW OF SEWAGE DISPOSAL PLANT AND SURROUNDINGS

Plant is in foreground. Building at right contains mechanical and electrolytic apparatus. Left of this are sludge beds, and left of these are the sedimentation basins. Buildings on the city's main street are seen at the extreme right.

frame and driven by a one-hp. motor, the speed of the brushes being about one foot per second.

The screened solids are allowed to drain into the grit chambers. They are then incinerated in a one-ton nominal capacity incinerator, during the winter season, but during the summer season the solids are buried. The screen room is the only place where raw sewage can be seen and the only place in the whole plant where any odor can be detected.

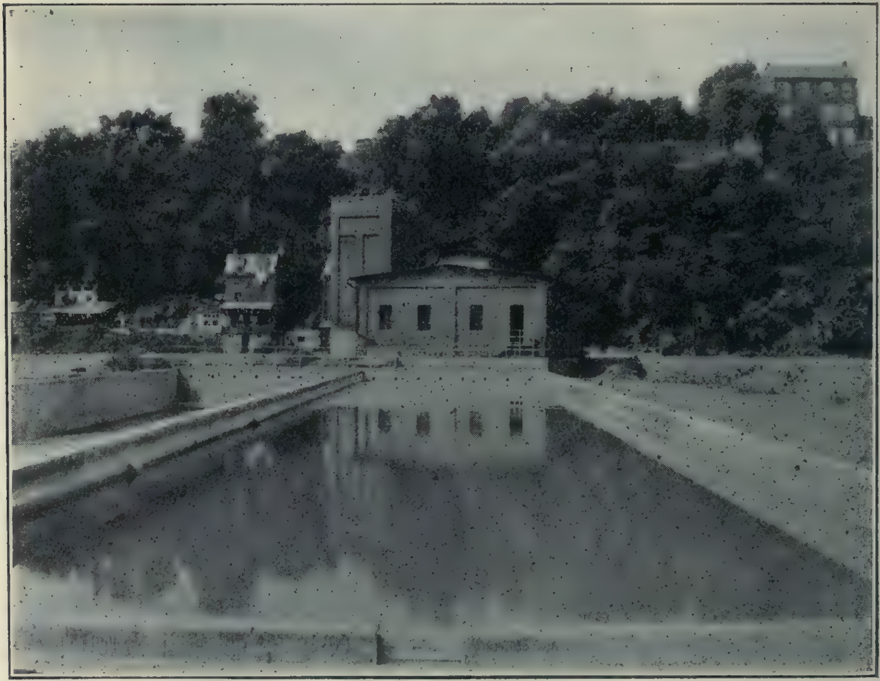

FIG. 2. BUILDING VIEWED FROM END OF SEDIMENTATION BASINS

Tower at left contains lime storage equipment. Basin outlet in foreground center. Residences are shown directly opposite building.

Grit Chambers

Under the screens are the grit chambers of approximately 270 cubic feet capacity. From the grit chambers the sewage flows over the overflow weir, thru the Venturi meter to the entrance of the electrolyzers.

Lime Tower

At some point in the line as far ahead of the entrance to the electrolyzers as possible and between the electrolyzers and the Venturi meter, pipes are connected to admit of the introduction of the lime which had previously been crushed, pulverized and stored in the lime tower. The lump lime is received in car load lots, transferred by truck to the plant where it is put thru six-inch grids to the crusher. After passing thru the crusher the lime is elevated and stored in the storage tank of 50 tons capacity. Each day when required the crushed lime is pulverized.

The lime feeders are operated by a one-horse-power motor and the equipment is in duplicate. From the effluent end of the electrolyzers treated sewage to be used as a conveying medium for the lime is pumped, requiring a two-horse-power motor. This is discharged tangentially to the frustum of a cone where it is mixed with the powdered lime and both are then discharged into the mixing tank or box. The lime in solution is then run into the pipe leading to the entrance of the electrolyzers where it receives the specific treatment of the process.

Electrolyzers

The electrolyzing units or electrolyzers, three in number, each with a capacity of one million gallons per 24 hours are of the appearance of an enclosed vat 3′ wide, 2′ 9″ high and about 27′ 3″ long. The top cover in two sections is securely bolted down resting on rubber gaskets to make the vat water tight. The cover is made in two sections to facilitate removal for examination and for cleaning. From the top cover two iron pipes lead upwards several feet to conduct any accumulated gases which may collect in the unit.

The electrolyzer is mounted on vertical wooden legs and over an outlet trench of concrete thru which any leakage flows to the sump pit. Underneath the units are located fourteen valves for the purpose of cleaning or emptying the machine and this waste sewage also flows thru the concrete trench to the sump pit. Sewage enters thru a 12″ pipe and after a travel of approximately one minute of time thru the machine emerges thru another 12″ cast-iron pipe at outlet end.

In the electrolyzer, constructed of cypress, are placed 22 sets of electrodes placed 11 sets superimposed above the other 11 sets. Each set of electrodes consists of mild-steel plates $\frac{3}{16}''$ thick and 10″ x 16″ in dimensions, bolted together at the four corners. Between the mild-steel plates and around the bolts are bushings of insulating materials which separate the plates $\frac{3}{8}''$ uniformly. The plates are connected and insulated that when joined in the electrolyzing circuit they are alternately positive and negative.

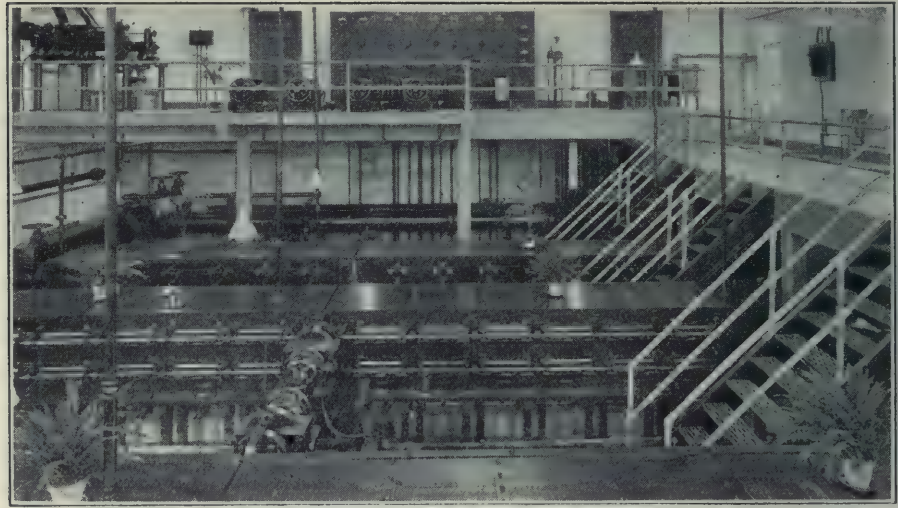

Fig. 3. View of Interior of Building

Electrolyzing units on the lower floor. Beyond these, at the right, the venturi meter, with its recording apparatus on the gallery above. On the gallery, at the right, the attendant's desk; in the center, the switchboards, one for each electrolytic unit. At the left, the lime feed apparatus.

In each space are two paddles $10\frac{1}{8}''$ in diameter constructed of non-conducting materials and attached to shafts extending thru holes in the plates.

These paddles are entirely insulated from the mild-steel plates. The 22 sets of 48 plates each or 1056 total, are set across the axis of the machine, the plates being vertical and parallel in rows. The spaces between the sets of plates and the cypress sides of the machine are blocked, thus compelling all of the sewage to flow thru the $\frac{3}{8}''$ spaces between the plates. The entire set of paddles are driven by a 3-hp. motor thru a double-reduction gear box rigidly attached to the machine and to two lines of protected bevel gears on the side of the machine attached to the shafts carrying the paddles. The bevel gears operate in oil.

The paddles keep the surface of the plates clear and free of sludge and debris. They also act as mechanical depolarizers. The speed of the paddles is about 20 r.p.m. At the bottom of the electrolyzer units are several valves thru which any accumulation of dirt or grit which may have accumulated, is drawn off.

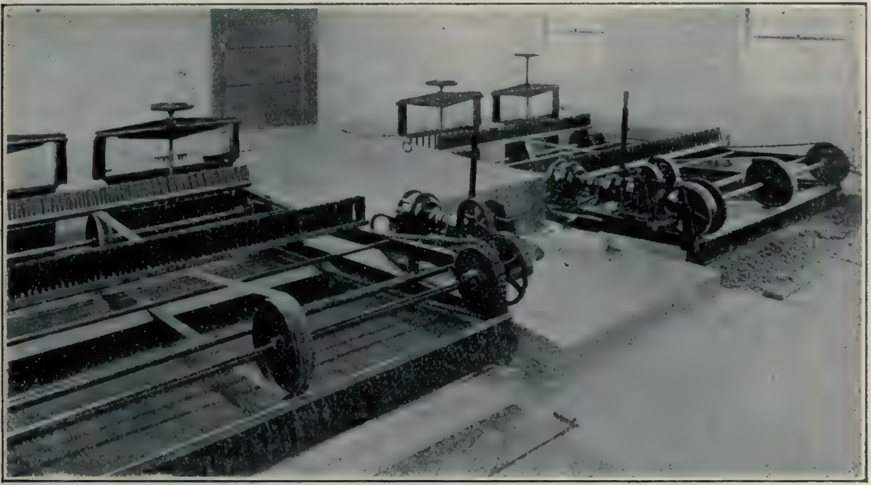

FIG. 4. SCREENS AND BRUSHES

Screenings can be seen on the floor in front of the righthand screen, where they are thrown by the brushes.

Power Board

On the slate power board are placed the controlling switches and meters, a rheostat to adjust the current delivered to the electrolyzers, a watt meter and a pole changer. The polarity of the electrodes is changed periodically to equalize the possible deterioration of the plates and to prevent the building up of the coating of the lime in any of the plates. The normal operation of the machine is at 45 to 55 volts and 50 to 55 amperes, the watt meter which registers the power to move the paddles operates under a normal load of 1200 to 2500 watts.

The cells in the electrolyzing unit receive a direct current from a 5-kw. generator driven by 7½-hp. motor. The paddle-turning motors are 3 hp. As each plate had an area of 120.2 sq. in. per side and as the 48 plates are electrically connected so that alternate plates have the same polarity, there are 47 sides having the same polarity and each bank contains 5649.4 sq. in. of positive and negative electrode area. The total positive and negative electrode area in the apparatus which contains 22 such banks, is therefore 124,286.6 sq. in. and the total number of paddles is 2068.

The efficiency of the apparatus becomes apparent for it is equivalent to compelling the sewage to flow between electrodes 30 feet high and 30 feet long spaced ⅜″ apart in which space 2068 paddles are revolving thus bring every particle of sewage into intimate contact with the electrodes and thereby utilizing the oxygen and hydrogen while in its nascent or atomic state.

Sump Pumps

Two low-grade gravity lines enter the plant to the sump pit and the main trunk line siphons are frequently drained to the sump pit for cleansing purposes. The two sump pumps are each operated by 7½-hp. motors. Each pump is capable of raising 600,000 gallons of sewage per day from the sump pit to the grit chamber. The pumps have electric automatic connections and with tell-tale attachment.

Auxiliary Equipment

To insure operation when the central power plant may be out of service a 30-hp. Fairbanks-Morse oil engine was installed which operates a 25-kw. a. c. generator. This can be started at a moments notice. Very few times however, was it necessary to start this unit during the year.

The entire equipment is housed in a building formerly used as a pumping station and is 42′ x 72′ in inside dimensions.

Sedimentation Basin and Sludge Beds

From the observation flume in the main building the sewage passes to and thru an elevated reinforced concrete flume 2 ft. x 3 ft. in section to the distributing flume at the inlet end of the sedimentation basin.

Here the sewage passes thru eight port openings 6″ x 6″ in section, the openings being regulated by adjustable port regulators to either one of two reinforced concrete sedimentation basins. The dimensions of the basins are 150 feet long by 31 feet wide and of depth at inlet end of 7 feet and at outlet and of 5′6″. The capacity of each basin is approximately 230,000 gallons. The basins are provided with 10″ valves to draw off the clear liquid at the outlet ends and at the bottom of the basins are 10″ valves to draw off the balance of the liquid, which passes to the sludge beds. Six-inch valves are also provided at the front ends. The sludge is drawn from each basin by gravity thru five underdrains and thru five 10″ valves.

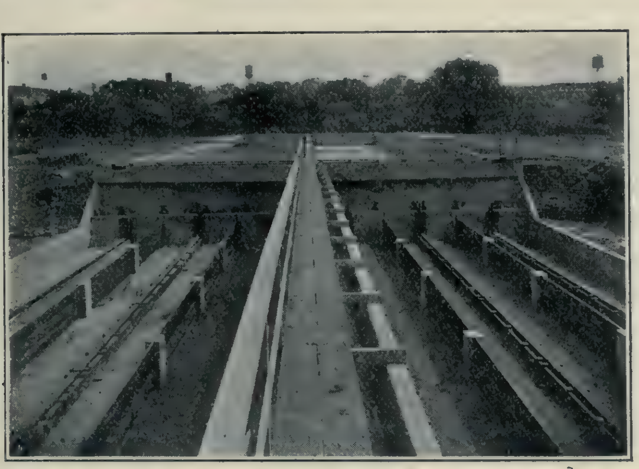

FIG. 5. SEDIMENTATION BASINS AND SLUDGE BEDS

View taken from building. Walk in center rests on flume carrying effluent to basins. Sludge beds are in foreground.

The former site of the basin was a swamp with soft soil bottom so about 300 reinforced concrete piles 10″ x 12″ in dimensions were constructed at the site and driven, on which to place the basin. The basin was thus anchored to prevent destruction by flood in the event that the filling around same be washed away.

Retention period in basins is from 1½ to 2 hours at full capacity of plant.

The sludge beds are 50′ long and 61′6″ wide divided by wooden partitions into six compartments. These beds are underdrained by half sections of vitrified pipe and above same are coarse stone, fine stone, and coarse sand for filtering medium.

During the past year the plant treated 73,000,000 gallons of sewage without the slightest evidence of nuisance or complaint and produced an effluent which was consistently and uniformly stable and of low bacterial count. The sewage is a normal sanitary sewage and its composition as well as the average composition of the effluent is shown in the following table.

Results of Sewage Treatment

	RAW SEWAGE	EFFLUENT (1 HR. SET)	PER CENT CHANGE
	p.p.m.	*p.p.m.*	
Suspended solids			
Total	150	69	−54
Volatile	110	46	−58
Oxygen consumed	17	8.1	−53
Free ammonia	21	13	−33
Nitrogen			
Dissolved	10.4	7.7	−26
Total	24.0	14.6	−39.1
Chlorine	117.0	123.0	+ 5
Alkalinity (as $CaCO_3$)	287.0	50*	
Bacteria			
Total 37°C	2,036,000	12,000	−99.6
B. coli	87,000	18	−99.98

* Causticity as CaO.

The sludge as removed from the sedimentation basin contains 94 percent moisture and amounts to 21 cu. yd. per million gallons. After 4 to 6 days drying on the sludge beds in normal weather the volume shrinks to 11 cu. yd. and the moisture content drops to 71 percent. Therefore when dry the sludge will amount to about 3 cu. yd. per million gallons.

It is interesting to note that the wet sludge as taken from the sedimentation basin was absolutely free of colon bacilli, contained 44,000 total bacteria and when diluted with river water and distilled water had a stability of over 99 percent with methylene blue in dilutions ranging from 1 to 25 up to 1 to 1,000.

During the year the sludge has in the main been satisfactorily used for filling around the plant, altho in some instances truckers have carted it away and used it on their farms, and they report that it is a very good growth stimulant, soil corrector, and improves the mechanical property of the soil.

Regarding the cost of operation, this will vary in different localities due to labor, the cost of power and to the hardness of the water supply. Allentown is unfortunate in this respect in that its water supply is well above the average in hardness and therefore requires much more lime than many other communities. However, during the past year accurate records of cost have been obtained and as the flow is continually increasing these data have been computed and checked and when the plant operates at full capacity or 3,000,000 gallons per day our figures show that the cost will be as follows:

Cost of Operation per Million Gallons at Full capacity of Plant (3 Million Gallons)

Power 213 kw.-hr., at 2.8 percent	$5.96
Lime 0.6 ton at $9.10 per ton (86 percent CaO)	5.46
Labor: Operators $135; 2 at $125; 1 at $100 per month, Laborers 2 men at 40¢ per hour	7.61
Heat	0.08
Light	0.17
Misc. supplies and repairs	1.02
	$20.30

Giving an operating cost of $20.30 per million gallons.

During the year several improvements have been made in the lime dosage, a new slaking chamber was installed, and the lime was added further upstream from the electrolyzers, giving better slaking and mixing, also affecting a saving of approximately 25 percent in the quantity of lime used.

Lately a new type electrolyzer was installed and tested out showing a reduction of 50 percent in the hydraulic head required as well as an electrical efficiency considerably greater than the older type. This unit was the same effective electrode area as the older ones but contains only a single row of 10 banks of electrodes and the agitators reciprocate instead of rotate, being driven from the top instead of the side.

Comment has been frequently made that the direct-oxidation process is no more efficient than lime alone. In this connection a great number of tests have been made at Allentown both by the city chemist and by other investigators and the results are conclusively in favor of the direct-oxidation process, which gives an effluent that shows a greater reduction in oxygen demand, oxygen consumed, organic nitrogen, and bacteria.

These tests also showed that the effluent produced by lime treatment, even tho practically sterile when discharged, will putrefy if mixed with river water, while that from the direct-oxidation process will stand up indefinitely. When we consider the experience of the British Royal Commission, where litigation arising from nuisance has invariably followed from the installation of lime precipitating plants, and also the findings of the Massachusetts State Board of Health, these comments are untenable for we have yet to encounter any nuisance at Allentown.

Conclusion

A very significant feature about the operation of the direct-oxidation process is that it is mechanical in nature and depends for its success, not upon the delicate adjustment of conditions in an endeavor so far as possible to favor the caprices of bacterial life, but solely upon simple mechanical contrivances whereby lime is fed into the sewage in sufficient quantities to render that sewage always slightly but definitely caustic, and thereafter to maintain an uninterrupted charge of electric current in the electrolyzers. Outside of these features the process is automatic.

Except in the screen room where the raw sewage passes over the screens there is no odor of sewage, stability being obtained in the electrolyzing units without production of odor.

No odors are present outside the building even from the sludge beds. Fly and mosquito nuisances such as are always prevalent at all other kinds of sewage disposal works are unknown at the Allentown plant. A system of this type can be located at any part of the city where favorable delivery of the sewage can be accomplished, and especially where little space is available. Long expensive trunk lines and isolation of the plant are therefore unnecessary, a great saving in dollars to the municipality.

The plant operates irrespective of weather or temperature conditions, purification being accomplished without the aid of living organisms and its operation is free from all uncertainties of bacterial activity, is not affected by climatic conditions or by changes in sewage, and is positive in action.

The variation in flow of sewage thru the electrolyzers up to the capacity of the unit has no effect upon the current required, in other words any quantity of sewage up to the capacity of the unit requires the same amount of current as the rated flow.

DISCUSSION

The following discussions cover the ground of the three preceding papers by Geo. W. Fuller, L. E. Gelinas and H. F. Bascom.

Colonel George A. Johnson: On casting up the net results of sewage-treatment practices to date, we are confronted by the indubitable fact that as a general proposition such developments in the art as have been made, if past practices may be so dignified by name, have not signalized the definite and reliable accomplishments which the steadily increasing pollution of our public waters demands. In no other branch of public sanitation has there been less real progress made. We still are trying to force a smile of satisfaction over the fact that sometimes, and on the average perhaps, we have succeeded in getting from our sewage treatment works the results we wish we could always get.

One prime consideration seems to rule the minds and consciences of sanitary engineers as a class today and that is that, since it is obviously impossible to make public surface waters sufficiently pure for primary uses by exerting every reasonable effort toward the ideal treatment of community sewage before its discharge into such waters because of the ever present opportunities for incidental and accidental contamination derivable from isolated residents on the watershed, travellers, campers and the like, all that need be done is to treat community sewage to the degree required to prevent the establishment and maintenance of obnoxious conditions in the body of water into which the sewage is emptied. This refers to:

(a) The elimination from the sewage of suspended matters which would otherwise deposit as sludge on the banks and bed of the stream or lake, later to putrefy, blacken the water, and give off offensive odors of putrefaction.

(b) The conversion of a sufficient proportion of the organic matter content of the sewage into stable compounds, thus to reduce the putrescibility of the sewage, or its demand for oxygen. This lightens the load on the diluting power of the waters of the stream, and allows larger amounts of sewage to be mixed with it without the establishment and maintenance of putrid conditions in the body of water receiving the sewage.

Thus bacterial purification of sewage is only incidental to any "purification" which it undergoes in the great bulk of the accepted sewage treatment processes of today. Keep the streams "sweet," attractive to the eye and inoffensive to the olfactory sense, and leave to the water-purification plant the job of making the water supply safe for human consumption. That is the concept of the sanitary mind today.

Now is this wise and is it sensible? I doubt it. Particularly do I question the soundness of such premises when I realize that the cost of ideal sewage treatment is one of the real reasons why we do not strive for higher degrees of sewage purification. Some years ago Hazen said that the public derived more benefit from one dollar spent for water purification than from ten dollars spent for sewage treatment. In a broad sense he was right. Money spent for water purification returns a *direct* measure of protection of the public health against water-borne disease. Money spent for sewage purification results in an incomplete and indefinite benefit. It *minimizes* the danger from pathogenic germs by reducing their number. It cannot give absolute protection, as can water purification, because even if every city, town and village in the country should treat its sewage to a point of innocuousness before discharging it into public waterways, it must still be remembered that those waterways drain areas populated or traveled by human beings whose excreta are not always collected in sewer systems, but sometimes are deposited at points on the watershed from which they find their direct or indirect way into the nearest stream or lake thus to pollute it, maybe dangerously, and in any event incontrovertibly to render all surface water potentially unsafe for human consumption unless properly purified before being delivered thru the mains to the consuming public.

In the early days of water purification we used to judge the efficiency of processes and systems by certain definite standards. The filtered water should not contain more than 100 bacteria per cubic centimeter; B. coli should not be present in more than a certain percentage of one-cubic-centimeter samples; the percentage removal of total bacteria should be such and so. You see, the ideal was not aimed at. A preconceived result, believed to represent the highest practicable degree of purification attainable, was the object.

Today, after thirty-five years practice beginning at the Lawrence Experiment Station of the State Board of Health of Massachusetts, we have "advanced" to a point where we judge the *efficiency* and worthiness of a process of sewage treatment by its ability to turn out a fairly clear effluent which by itself will remain stable for a few days. Everything else is incidental. High bacterial purification is considered desirable, but no particular point is made of it. Even when the requirements are the most exacting, we are willing to accept a process which produces a "sweet" effluent, even tho it may contain 200,000 bacteria per cubic centimeter, some of them much of the time almost sure to be pathogenic to man.

Why are we willing to allow sewage-treatment plants to pour uncountable billions of bacteria into our public waters every hour of the day, when such waters must be used later for public supply? Why are we willing to accept sewage-treatment works which we know with positiveness will fail several times during an average year, particularly during cold weather? Why do we complacently impose upon the water-purification plant the full responsibility of protecting the public health against water-borne disease? Let us endeavor to answer these three questions with considerable deliberateness.

We have said that the most complete and widespread purification of municipal sewage will not conserve the pristine hygienic purity of surface waters. We have recited the basic concept of sanitarians, in effect that the one important purpose of municipal sewage treatment is to keep such waters sweet and attractive. We know that water-purification systems can be relied upon to render water of almost any degree of corruption pure and wholesome for human consumption. A dollar spent for water purification will return a definite measure of protection of the public health; ten dollars spent for sewage purification will but minimize the danger from water-borne disease. Those are the reasons so broadly accepted today.

Cannot the professional mind, and conceivably the public mind as well, be awakened to the fact that in all endeavors team work will always yield the surest and best result? Among those branches of public sanitation which have for their purpose the conservation, not only of the comfort and well being but also the life of the body politic, what element, or collection of elements in preventive medicine are in greater need of coöperative, well-balanced team work than the various branches of sanitation which reach their culmination in the production of a pure public water supply? As clean a watershed as in feasible in the first place; diversion out of the watershed of as much of the human wastes as is practicable of accomplishment; competent, untiring and sympathetic watershed patrol; purification of community sewage to the highest practically attainable; and the purification of the water supplies derived from these watersheds by the most modern and complete methods, carefully, intelligently and conscientiously applied. This is sanitary Utopianism. Can we afford to do less? What is the cost of so doing, and what will be the case if we do not?

Every intelligent community observes all of the above principles of good water-supply sanitation except one, that of insisting upon the purification of community sewage to the highest practicable degree. It is not strange that this is so. Every other step in the succession of factors leading up to the procurement of a pure water supply is a personal matter. No one deliberately fouls his own nest, nor would a person thinkingly pollute the watershed from which his water supply is derived; and money with which to support a watershed patrol whose duty it will be to keep it clean will be cheerfully forthcoming. No one who has reasoning power will be satisfied with anything but the best obtainable in the line of water purification.

But with sewage purification it is different. If it were the rule for every community to purify its sewage thoroly and not incompletely and uncertainly as is almost always the case, all would be well; but where only the elimination of gross nuisance in streams is the prime consideration, as we know it mostly is, it is not easy to convince the people of one municipality that they owe a debt of common decency to their neighbors which they should pay, even if their neighbors are not similarly minded, and so become pioneers in a movement which would do so much toward actually cleaning up our public waterways and lessening the growing burden on water-purification systems.

One necessarily comes to a point of debating whether the accepted purpose of sewage treatment is to hide the sewage, or whether its treatment is undertaken in an honest endeavor to improve the health and comfort of the public. If the former, the millions of dollars which the municipalities of America are spending annually to secure a fairly definite *average* result is tolerably poor sanitary finance. If the latter, then the sanitary mind has been proceeding at snails pace for a generation.

Now everyone knows, or should know, that of all the processes of sewage treatment in practical operation today there is only one which for its success does not depend upon the capricious activities of bacterial life. The "direct oxidation" process is not a biological system but a combination of mechanical devices depending not at all upon bacterial actions, (which fail signally at times and at best are unreliable), but merely upon the faithful operation of certain relatively simple mechanisms. An effluent results which is practically free from suspended matter, which is stable, and which contains but very few bacteria. Furthermore, the effluent is uniformly stable, as is the sludge, which remains stable, which is true of the sludge from no other process. Moreover, there is no local nuisance created around such plants, something which has never before been true of any other type of sewage-treatment works. All of these facts were well demonstrated during my recent test of the direct-oxidation plant at Allentown, Pa.

Doubtless this system will be improved as time goes on, by better design and better operating practices; but the main thing is that the process is basically sound; that it does the work and consistently, too. Perfection of the design and methods of operation can well await further study.

The cost of sewage treatment by the direct oxidation process is fairly comparable with that of other well-known methods which are far less easily managed, less reliable, and all of which are certain nuisance breeders in some particular and in varying degree. At Trenton, N. J., for example, where I am preparing plans for a plant of this type, the total cost of treatment, including all charges, is estimated at about $20.00 per million gallons.

It is true that this process is patented, as is some of the apparatus used in it; that it is exploited commercially. I cannot see, however, wherein these facts need be given adverse consideration. We can use other processes, even the patented Imhoff tank, and obtain inferior and always uncertain results at less cost; or we can use this process, which, in the minds of some oblique-minded people, bears the stigma of a commercial exploitation, and obtain what we want and need, continuously and reliably, winter and summer, and at reasonable cost.

Must we shut our eyes to the advantage of definitely cleaning up out public waterways, continuously and permanently, and not as an intermittent and incomplete proposition, merely because a process which gives great promise of being able to serve this purpose best is a patented one susceptible of commercial exploitation? Some municipalities and some engineers adopt a discriminatory attitude toward patented devices, in some cases with good and sufficient reason, no doubt; but, in the case in point, if we favor the direct oxidation process over all others, solely because of its merits and potentialities, and where cost factors are not clearly prohibitive, are our efforts to be discredited on the questionable grounds of unreasonable bias and unwarranted idealism?

T. Chalkley Hatton: Mr. Fuller has well stated in his valuable paper that "the use of electricity as a purifying agent has appealed and continues to appeal fascinatingly to the lay mind." He might have gone a step further and stated that to many lay minds electricity can accomplish almost any service if properly applied; that because of its *mysterious workings* its field is practically unlimited and therefore it has again and again in the past 30 years at least been used to remove the impurities from sewage-laden water, and I fancy there is not an engineer familiar with sewage treatment work who has not had more or less to do towards either trying out some process of sewage or water treatment in which electricity plays a part or has given such a process very considerable study.

In spite of this history, however, up to date no sewage or water-treatment plant has been built of any considerable magnitude where electricity plays an important part.

Several small plants have been built in Texas and a few in California where electricity was used as the sole purifying agent. All of these but one have been abandoned. Two small plants have been built where both electricity and lime have been used—the Phillipsburg and Allentown plants referred to in Mr. Fuller's paper.

I believe each of these plants has three electrolyzers, each of one million gallons capacity, and up to date neither of these has been operating at a rate of one million gallons for the whole works. The sewage so far treated is extremely weak, ranging from 60 to 80 p.p.m. of suspended matter with low oxygen requirements, so there is no published record of either plant which would warrant the engineer in concluding that they could continuously and satisfactorily treat a typical city sewage at rated capacities or what cost of treatment would be.

Mr. Fuller states that an extensive set of tests was made by the New Jersey State Board of Health last spring but has not yet been published; why this information has not been given it would be interesting to learn, especially in view of the fact that those parties interested in introducing the direct oxidation process have been so active since that time. He also states that the Easton experimental plant was studied by several Philadelphia engineers and chemists; he did not state, however, that the Franklin Institute of Philadelphia awarded a medal to Mr. Landrith on the basis of a few days' test of this plant.

It has been my privilege to read within the past few days a detailed report of tests made of the Allentown Plant under the direction of Colonel Johnson. This test covered a period of 31 days, from July 18 to August 18, 1922, during which the average daily flow was at the rate of 409,400 gallons and the maximum flow 700,000 gallons for 24 hours, or from 40 percent to 70 percent of the rated capacity of one unit. The sewage was treated at these rates for three different periods of the day, the flow in the sewers being too low to provide for a continuous daily operation of the plant, and the sewage was considerably below the average city sewage in carbonaceous and suspended matters, and was therefore not typical of average American sewage.

There were 57 tests made, divided into five groups, which appears to me to be far too few to warrant Colonel Johnson or any other careful engineer of his type to make the statement contained in his discussion on page 195, to wit:—"The direct oxidation process depends upon the faithful operation of certain relatively simple mechanisms. An effluent results which is practically free from suspended matter, which is stable, and which contains but very few bacteria. Furthermore the effluent is uniformly stable, as is the sludge, which remains stable . . . . that there is no local nuisance created around such plants, something which has never before been true of any other type of sewage treatment works."

In view of the fact that before reasonably safe conclusions could be drawn of the reliability of the activated sludge process a great many able engineers and chemists all over the civilized world been conducting extensive experiments and investigations for a period of several years, and hundreds of thousands of dollars have been spent in testing out every phase of the process, Colonel Johnson's conclusions upon this new process of direct oxidation are, to say the least, heroic, as are also his conclusions as to the cost.

It reminds the writer of his sad experience in drawing his first conclusions of the cost of the activated sludge process after a year's intensive study and experiment, when he felt warranted in stating that the outside gross cost would be about $20.00, but as the experiments continued and more data were secured he found the cost more nearly approaching $35.00 per million gallons, this cost to be reduced by the amount the dried sludge will return when sold as a fertilizer.

Colonel Johnson estimates, in his discussion, page 195, that the plant he is designing for Trenton will treat that city's sewage for about $20.00 per million gallons, including all charges; my recollection is, that in his report to Lima, Ohio, as referred to in Mr. Fuller's paper, the cost was about $45.00 per million gallons, which included the cost of sludge drying. If he proposes to dry his sludge by means of filters and dryers, as suggested in his report to Lima, and using the vacuum filters, as mentioned in Mr. Fuller's paper, the drying alone, based upon our experience in Milwaukee, will cost him from $20.00 to $30.00 per million gallons of sewage, with very little, if any, return from the sale of a sludge devoid of nitrogen, phosphorus or potash.

The drying of sludge of this character upon drying beds is a simple matter in warm dry weather, but it has never been and never will be successful during seven months in the year in our climate.

The solution of the sludge problem is very lightly passed over by those who recommend the direct oxidation process and yet all those engineers who have built sewage-disposal plants of any considerable magnitude, both in this country and abroad, realize more and more as these plants are operated, that the proper disposal of sludge resulting from any type of sewage treatment is the largest part of the problem, and one which must be faced sooner or later by every community operating a sewage-treatment plant; and when such enormous quantities of sludge are to be disposed of as the direct oxidation process produces, the problem of its disposal becomes naturally a costly and troublesome one to solve, even tho the sludge may be inodorous.

To the writer's mind there has been no scientific proof that the direct oxidation process is far different in results from the "excess lime" process which has long since been abandoned after years of unsuccessful effort. The process depends upon the precipitation of calcium carbonate and iron hydroxide and upon the production of hypochlorites by electrolysis, but the sewage is not freed from the great bulk of the solid organic matter.

It has not been proven up to date, in spite of the stability of the effluent by the methylene tests, that this effluent would cease to be a nuisance after its causticity was diminished by mixing with the waters into which it was discharged, in fact there is very grave doubt of it.

It has not been proven to the writer's satisfaction at least what the cost of electric current would be to operate a million-gallon unit to full capacity month in and month out. Our experience in Milwaukee with the Lautzenheiser electrolytic process was that with new plates when treating typical sewage at full rated capacity we secured admirable results for a few weeks; that we started off with five volts on the plates and increased to 100 volts within a period of four weeks; that the amperes started at 70 and were reduced to less than 40, and that the weight of the electrodes diminished consistently in proportion to the sewage treated.

There can be no doubt that the electrodes rapidly diminish in weight and must be replaced; that a machine with so many moving parts as the Landrith electrolizer contains requires expensive upkeep and that the known complexity of the varying conditions of the average sewage naturally imposes a corresponding varied service upon the machines, which influences very largely the cost of operating this direct oxidation process.

It is not the writer's desire to cast any reflection upon the value of either the Phillipsburg or Allentown sewage-disposal plants, but until they have fully demonstrated their worth by a long-time test to their full capacity when treating typical American city sewage and reliable records have been secured and published, it would seem logical to go slow towards the general adoption of this process by engineers who are responsible for the expenditure of public funds in such large amounts as sewage treatment requires.

F. N. MOERK: I was particularly interested in Mr. Hatton's discussion, Mr. Fuller's paper and Mr. Johnson's comments.

Mr. Hatton in his discussion conferred the suggestion that the sewage at Allentown was relatively weak. The analysis of the sewage at the disposal plant shows it to compare favorably, in fact almost identically, with that at Worcester.

Another point that he brings up is when he says he cannot understand why at Lima the estimated cost is somewhat around $58 per million gallons, while at Trenton the estimated cost is in the neighborhood of $20. The point in brief is this: At Lima the lime demand is exceptionally heavy, registering as nearly as we can tell by analyses, which were checked, about 2600 pounds of 90-percent lime, while at Trenton, by the same means it was only 850 pounds per million gallons.

In regard to the stability of the effluent, there is no question about this, for repeated tests have satisfactorily demonstrated its ability to stand up. During the Allentown tests samples were taken after treatment with lime alone and with lime and electricity combined, and after standing for one hour, put into containers at dilutions of four to one with river water. These samples were allowed to stand for several days at a temperature of 30°C. The difference in dissolved oxygen absorbed between these comparative samples was that the lime-treated samples had no dissolved oxygen present at the end of the time, the maximum quantity present being two parts per million, while uniformly and consistently those treated in accordance with the process whereby lime was administered and electricity used, contained dissolved oxygen to the extent of six parts per million at the end of five days, showing an absorption of one and five tenths parts per million against four to six parts with lime precipitation.

In regard to the uncertainty of the operation of the plant and the method of handling sludge, we have been going into detail on the same experiences that Mr. Hatton has had with the hydrogen-ion measurement. The Leeds and Northrup Company has perfected an instrument which records the hydrogen-ion concentration on a chart and which may be calibrated so that excess lime is recorded in parts per million. We contemplate installing two of these machines, one giving us the lime demanded at the downstream end and another showing the excess lime just as the sewage runs into the sedimentation basins. These will be mounted by the lime feeders. We will thus have graphs of the lime control, the sewage flow and all the power used. The meters showing the voltage and amperage on the electrolyzers will be of the recording type.

As far as the sludge problem is concerned, future plants will be equipped with Dorr thickeners, and at Trenton the sludge from the plant will be used as a fill, as it is stable and inoffensive. The sludge will amount to approximately 1200 pounds per million gallons, so far as we have been able to determine from the analysis of samples.

All in all, the aim is to have the process as mechanically perfect as possible, using graphs as the controls, so that we know just about what we are doing continuously.

In the matter of disposal of sludge, the U. S. Bureau of Agriculture gives the value on sludge, based not on nitrogen, but primarily on the calcium carbonate content. In their estimate of value they report that it is equivalent to hydrated lime expressed as calcium oxide on the basis that two parts of calcium carbonate are equal to one part of oxide. In dollars and cents it means that with hydrated lime at $13 per ton, the sludge is worth at least $5 per ton.

Regarding the drying problem, Mr. Hatton says that at Milwaukee it will cost them about $20 per ton to dry this sludge. He loses sight of the fact that his sludge is radically different from that of the direct-oxidation process, which is readily dewatered. In fact, actual tests of the Allentown sludge in the physical apparatus made by the Filtration Engineers of New York City, have shown that the sludge may be dried to 10 percent moisture at a cost of $2.96 per ton.

Glenn D. Holmes: I would like to add a word of explanation in regard to the Syracuse experiments mentioned in Mr. Fuller's paper, page 157, which states: "It was found that the velocities should not exceed 1.75 feet per minute, and that the detention period need not be more than about three-quarters of an hour."

Our demonstration plant was operated at velocities of 12.5, 25, 50, 75, 100, and 150 feet per hour (0.21 to 2.5 feet per minute) and within these limits the velocity was found to have no effect upon the removal of suspended solids. The percentage of removal depended entirely upon the time of detention within the tank and the strength of the crude sewage.

The three-quarter-hour period mentioned is the time of detention necessary to secure a removal of about 60 percent of the suspended solids, Syracuse sewage. A 15-minute detention gave a removal of 50 percent while about 3½ hours were required for 70 percent removal. The above percentages are for sewage of 275 p.p.m.

In comparing the results of sewage treatment at different plants, on the basis of removal of suspended solids, the strength of the crude sewage must always be kept in mind as the removal is very largely dependent on this factor. With strong sewage a much greater percentage of removal can be accomplished in a given detention period than with weak sewage. Referring again to our experimental work, it was found that a detention period of three-quarters of an hour would accomplish a removal of 53 percent for sewage of 150 p.p.m.; 60 percent for sewage of 275 p.p.m. and 67 percent for sewage of 500 p.p.m.

Mr. Eddy: The papers we have listened to this morning have been exceedingly interesting, as have also the discussions of Mr. Johnson and Mr. Hatton.

After about the same number of years' experience with the problems of sewage disposal as Mr. Johnson has had, I differ from him slightly in my point of view upon some of these problems. Ideals are not only very desirable, but they are also very necessary. I believe that we should have ideals and high ones, in the building of sewage treatment plants. Every plant that is built attractively and free from objectionable conditions brings us just so much nearer the ideal. But there is a limit beyond which practical considerations forbid our going. We must take into account the cost.

Now the principal thing in which the sewage treatment plants in this country have not come up to the desired standard, has been their operation. There have been rather few cases where design and construction and even methods have been such as to cause the plant to be justly termed a failure. There have, of course, been improvements from time to time. There will always continue to be improvements in methods and designs; but we seldom seem to secure satisfactory operation.

Now that is a very vital criticism, or defect, applicable to some of our treatment processes, and I believe it applies with particular force to the "direct-oxidation" process which we have considered this morning. It certainly applies to the activated sludge process in many instances. However good the effluent may be, however complete and satisfactory the disposal of sludge may prove, the indication is, certainly with present fertilizer conditions, that our annual operating expenses are going to be high.

The situation that confronts us in the art of sewage treatment is that usually we are practically unable to secure sufficient funds to properly operate our plants in a first class manner. Therefore as a general principle, if we can secure substantially the conditions which are necessary and at the same time keep our operating expenses down, that is the policy which should largely control.

I know nothing about the details of the estimate which Mr. Fuller has presented, but at Lima the figures appear to be $40,000 for operation of the direct oxidation process, and $15,000 for the other. The difference is $25,000 a year, which is not an easy thing to obtain from the taxpayers of a rather small city. That difference, if capitalized at five percent, makes the investment cost of the one process $900,000 against some $690,000 for the other.

Now, if it be true that either process will serve the purpose equally well from a practical standpoint, there must needs be some advantage other than the satisfaction of an esthetic ideal to justify the greater annual operating expense. Also, the comments which Mr. Hatton has made with respect to the lack of demonstration of the direct oxidation process seem to me very pertinent.

The report which Mr. Bascom has given us this morning has been very favorable. I will not say optimistic, because I do not know enough about the local conditions to warrant. I have not studied the Allentown plant. But the information given by Mr. Bascom certainly is worthy of careful thought.

I do believe, as a general principle, we should govern our expenditures for sewage treatment with a view to keeping down the annual operating expense. It is comparatively easy to get the initial cost, the funds required for construction, because there is generally some local sentiment in favor of the project; but to get the annual appropriation has been a very serious matter. Colonel Johnson has referred to the difficulty of convincing the public that they should expend money for the benefit of their neighboring town's sewage. But if it is difficult to get $15,000 how much more difficult it is going to be to get $40,000. These are the practical difficulties that we are facing, and if we do not get the money for processes of this kind where are we going to be? The lime will be cut down. The apparatus will not be kept up. The power will not be supplied.

It seems to me that we should consider very carefully this matter of annual operating expense, as well as many other matters in connection with this and other processes.

I just want to comment briefly on Colonel Johnson's remark about patented processes. I have never had a feeling that we should refrain from using and taking advantage of patented processes. We are doing it all the time in engineering matters. Why should we not do it in sewage treatment?

Referring to Colonel Cleveland's paper this morning, there is a patented process, a machine, for which he deserves very great credit. The persistence and conscientious effort and study that he has put into the creation of that machine has resulted in making it a practical factor in the solution of one of our most difficult problems.

Mr. Bascom: I'd just like to remark that I have not as yet heard that any of the engineers have inserted figures in their estimated costs of operation to provide for damages from lawsuits and possible lawsuits on account of the failure of operation of the plants which is so prevalent in a great many cities of the country. There is a warrant for paying a higher operating cost and obtaining a clearer and purer effluent as against fighting continual lawsuits as some cities have been doing.

There is another point I want to make. We will confess that there is not much information about this process available. In my preliminary remarks, I stated that the public must be patient in this matter. We have operating costs and data. We have more than we have given you today, but Rome was not made in a day. Sewage disposal plants have been in operation for thirty or more years and our plant has been in operation for fourteen months. We gave you part of the information today. We have a whole lot more. We will give this to you at the proper time. This is not the place to hand out all conclusive evidence and, as the Dean of the Art School said last night, "I think we have convinced you," and we will give you proper figures at the proper time.

Mr. Fuller: I would like to say a word or two in closing. Mention was made of sludge and revenue from it. I was a little surprised that Mr. Bascom did not point out the availability of the Allentown sludge for statuary. I think perhaps he would get his best line of revenue from that direction.

In regard to the use of lime in a very finely divided form, it is my understanding that those who operate lime quarries and have much lime dust find a good deal of difficulty in marketing it because of freight charges.

I want to say just a word or two on the technical aspects as brought out by Mr. Moerk, the chemist of the Municipal Sewage Disposal Co. I share with him the feeling that we may get a good deal of benefit from the operation of these new fangled devices that give you a pH point or something like that. What they mean I do not know, but I do know from the standpoint of one who has applied lime in these processes, that he has a variety of things to look out for. In the application of the electrolytic process to the sewage of Lima, Ohio, where the sewers are on combined plan and deal at times with storm water, as well as with varying conditions of the water supply in point of hardness, what has he to do?

He has to look after the lime application in respect to free carbonic acid and the half-bound carbonic acid, both of which vary at different seasons of the year. He has to look out for a miserable task, owing to slowness of reaction even in the presence of much mixing and agitation, with which all water-softener men are familiar, in that he has to apply two equivalents of lime to one of magnesia. The content of the latter varies, not only due to its varying content in the water supply of Lima, but also in the infiltration water and storm water in the sewage. This process, Mr. Moerk says, calls for a certain amount of causticity. In plain English this means lime water in excess of what combines with this sewage as it goes thru the cells. In order to have the process work to advantage, that excess quantity is stated to be 30 to 50 parts per million, maybe 80 parts. In order to get a dose of lime to give this desired amount of causticity, he has first to top the aggregate combining power of three variables, free carbonic acid, half-bound carbonic acid and magnesium. Water-works men know this is very difficult at times with surface-water supplies, and with the process under discussion this has to be done with the fluctuating flow of a combined system of sewers.

I am not saying this as an indication of discouragement. I am just trying to make a little practical comment on the discussion by Colonel Johnson in which he speaks about mechanical processes being easy to handle. They are, when all goes well. Many of these water plants in which lime is used have been in service for a good many years, rather than a few months, and also under varying conditions; and I think that some of these operating people have had to stay up nights many times in order to apply lime suitably.

In regard to the question of policy, I just want to say a word or two to refresh your memory. This country has followed England quite generally in the line of sewage-disposal practice. England is a densely populated country. Its rivers are relatively small. Their sewage problems came to them earlier than they did in the United States. In 1876 they actually passed thru Parliament a River Pollution Prevention Act which called for a very high grade of sewage effluents. Did they get anywhere along this line? They absolutely did not. People would not spend the money. They encountered a comparison of the cost of such sewage treatment with the relative advantages of public expenditures for water works, for hospitals, and for various lines of welfare undertakings. The people decided that they did not propose to spend money for sewage treatment in that way, and they did not. Whatever was done in England during that period of development was at the tail end of a lawsuit. After some 18 or 20 years they found that they were getting nowhere, so they took account of stock, created a royal commission on sewage disposal and made investigations. That step did get them somewhere ultimately, but progress did not come as a result of trying to force the adoption of ideal arrangement such as Colonel Johnson talks about.

Disposals plants should be designed in an adequate way to take care of all reasonable future requirements and they should be built on a program which will allow a community to put in works in accordance with its means and so as to serve the best interests of that community and with due regard to that of its neighbors. As the years go by and the needs come forward for a higher degree of purification, the disposal arrangements should be extended and operated, so as to meet the advance in requirements under the local conditions.

I am firmly convinced that such is the way to go at these things in this country. Get things started and get them started right, but if you try to get the blunt end of the wedge started first, I believe that it brings about, generally speaking, absolute inaction. You get nowhere.

REPORT OF SUB-COMMITTEE ON PUBLIC COMFORT STATIONS

H. F. Bascom, Chairman, Allentown, Pa.

The Sub-committee on Public Comfort Stations presents herewith the tabulated results of its efforts for the year 1922 to date, in the matter of statistics of public comfort stations in the United States and Canada. Our committee sent 310 return post cards, to each of six of the largest cities of each state in the Union, and in addition several to the cities in the Dominion of Canada. Replies were received from 67 cities in the United States, and two from Canadian cities.

In addition, thru the department of Internal Affairs, Bureau of Municipalities of the State of Pennsylvania, Mr. J. Herman Knisely, Chief of Bureau, very kindly assisted in obtaining quite complete returns from cities and boros of the State of Pennsylvania totaling 54 locations.

It is rather surprising what little interest seems to be taken in this very sadly neglected branch of public service. Returns came as follows: One from the city engineer of a city, the capital of a state, "What in h—— is a comfort station," another says "Other arrangements made when large crowds are in town," one city reports, "No sites" another says, "None because of no park." Another "Nothing known about the building of one," while another reports "No one ever started the ball a rolling." The city of Washington D. C., seems to be the only location where the subject seems to be receiving proper consideration.

It is probably useless to attempt to juggle costs, populations served, populations not served, revenues, expenditures, or even to make any summary, for the returns are so incomplete that the results would be of little value.

1. Statistics of Comfort Stations in United States and Canada

CITY OR TOWN	POPULATION 1922	STATIONS IN PARK	COST	UNDER STREETS	COST	ELSE-WHERE	COST	TOTAL
1. Aberdeen, S. D.	16,000	1	$1,000					
2. Albany, N. Y.	115,000[1]							
3. Albert Lea, Minn.	8,096[2]							
4. Allentown, Pa.	86,000	2	2,000	1	$42,000	3	$46,000	
5. Asheville, N. C.		1	2,800					
6. Augusta, Me.	12,500							
7. Barre, Vt.	10,734[3]							
8. Beatrice, Neb.	10,200					2		
9. Bellingham, Wash.	35,000	4	1,500	1[4]	1,200	2	6,000	$8,700
10. Birmingham, Ala.	190,000	None[5]						
11. Boston, Mass.	764,017			2		7	53,360	
12. Brigham City, Utah		1				2	4,000	
13. Camden, N. J.	116,000	2		1	25,000	3		
14. Charleston, S. C.								
15. Clarksburg, W. Va.	30,000					3		
16. Columbus, Ohio	250,000	4	20,000	2	25,000	6	45,000	
17. Concord, N. H.	22,167	1	200					
18. Covington, Ky.	59,000	2						
19. Des Moines, Iowa	140,000	10	5,000			2	5,000	
20. Detroit, Mich.	1,000,000	22		2	46,000	14		
21. Duluth, Minn.	100,000	10	1,500	0		2[6]	500	
22. Easton, Pa.		1						
23. Gallup, N. M.	5,123[7]							

[1] Contemplating the erection of several.
[2] One in Court House—maintained, one-half by city, one-half by county.
[3] Public toilets in City Hall—other arrangements made when large crowds in town.
[4] Two at Tourists' Parks.
[5] Inability to secure suitable location and handicapped with financial troubles.
[6] Also two at Tourists' Camp.
[7] None because of no park.

1. *Statistics of Comfort Stations in United States and Canada—Continued*

CITY OR TOWN	POPULATION 1922	STATIONS IN PARK	COST	UNDER STREETS	COST	ELSE-WHERE	COST	TOTAL
24. Durham, N. C.	30,000					1	3,000	3,000
25. Enid, Okla.	21,000	6	1,500			6	1,500	
24. Galveston, Texas	44,255	1	5,000			1	5,000	10,000[8]
25. Grand Island, Neb.	14,500	3		1		4		
26. Grand Rapids, Mich.	140,000	1	8,382			1	7,492	15,874
27. Greenville, S. C.	25,000	1						
28. Hartford, Conn.	148,000	2		2				
29. Harrisburg, Pa.	8,000	3	6,000	—[9]				
30. Idaho Falls, Idaho	7,500	4	6,000 to 15,000			1[10]		
31. Jackson, Tenn.	19,000	1[11]				1[12]		
32. Kalamazoo, Mich.	50,000					1	12,000	12,000
33. LaGrande, Ore.	7,500	2						
34. Lawton, Okla.	10,140	6	500 each			3	200 each	3,150
35. Lewiston, Me.	34,000[13]							
36. Lincoln, Neb.	55,000	6		1[14]	6,000			
37. Logan, Utah	10,800							
38. Lowell, Mass.	112,759	1	9,000	1	28,300	2	37,300	
39. Lynchburg, Va.	30,000	4		—[15]				
40. Lynn, Mass.	99,148	2	10,000			2	10,000	
41. Macon, Ga.	52,500	1[16]	3,000					
42. Madison, Wis.	42,200	4	About 2500 each					
43. Monroe, La.	15,000	None						
44. Muskogee, Okla.	35,000	5		—[17]				

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[8] Gifts of a citizen.

[9] Just building one at the cost of $44,000.

[10] City Hall.

[11] At water plant.

[12] At Court House.

[13] Nothing known about the building of one.

[14] Rest room basement of City Hall.

[15] Has not been necessary to date.

[16] Underground.

[17] Not needed, plenty of other public or service stations well scattered.

45. Newark, N. J.	450,000	1[18]						
46. New Britian, Conn.	61,000	1		—[19]				
47. New York City	5,839,000	6	159,060	5	110,304	11	269,364	
48. New Haven, Conn.		5						
49. New Orleans, La.	400,000	15	44,700					
50. Ogden, Utah	35,000	4	75,000	1	60,000	5	135,000	
51. Olympia, Wash	8,537	5	875			1[20]		
52. Pendleton, Ore	8,000					1[21]		
53. Philadelphia, Pa	2,000,000	14	140,000	1	17,000	15	157,000	
54. Portland, Me	72,500	1				1[22]		
55. Providence, R. I.	241,000	2		2	49,019			
56. Quincy, Ill	38,000	2	28,000					
57. Reading, Pa	107,784					2	67,000	
58. San Diego, Cal	90,000	3	600	2	8,150	2	600	9,350
59. Sioux City, Iowa		None[23]						
60. Syracuse, N. Y.	185,000			2	6,800			
61. Terre Haute, Ind	67,000	None[24]						
62. Trenton, N. J.	119,000	2	4,000	1	35,000	1	71,000	110,000
63. Washington, D. C.	470,000	10	80,000	2	50,000	4	56,000	186,000[28]
64. Vicksburg, Miss	18,000	None						
65. Waterbury, Conn	100,000	1	1,000			1	19,000	20,000
66. Wichita, Kan	80,000	6[25]						
67. Troy, N. Y.	75,000	2	17,400			1	2,000	19,400
Canada								
68. Regina, Sask	37,000		25,000[26]					
69. Vancouver, B. C.	135,000	2	4,000	1	15,000	4[27]		

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[18] Underground in county parks. [19] Station proposed—$30,000 in 5 year notes proposed.
[20] One in Standard Oil Service Station. [21] One in City Hall.
[22] Demand not urgent enough. [23] Are contemplating the erection of several stations this year.
[24] The necessity has never brought up the question forcefully. [25] Lots of talk—disagreement as to location.
[26] Appropriated for station and street railway waiting room. [27] Under construction.
[28] More expected

2. *Statistics of Comfort Stations in Pennsylvania*

CITY OR BORO	POPULATION 1920	POPULATION 1922	STATIONS IN PARKS	COST	STATIONS UNDER STREETS OR SIDEWALKS	COST	STATIONS ELSEWHERE	COST	TOTAL NUMBER	TOTAL COST	REMARKS
1. Allentown	78,580	86,000	2	$2,000	1	$42,000			3	$44,000	
2. Altoona	60,000	65,000									Short of funds.
3. Ambridge	12,730	12,000									
4. Berwick	12,181	12,600	1								At city hall.
5. Bethlehem	54,000	54,000	1	$10,000	1	$8,000	2	$18,000			
6. Braddock	23,000	23,000									
7. Bradford	15,500	16,000					1				At Board of Commerce Rooms. Lack of revenue.
8. Butler											Station at court house maintained by County of Butler
9. Carnegie	12,000	12,000									
10. Chambersburg	13,700	14,000					1	$300			Basement of court house. Lack of interest.
11. Charleroi							2				Municipal Building.
12. Columbia	11,000	11,000									
13. Connellsville	13,804	15,000									Matter taken up, something to be done in near future.
14. Corry	7,228										
15. Donoro	15,170	16,000									Indifference.
16 Dubois											
17. Duquesne	19,011	19,600	2								At playgrounds. No records kept.
18. Easton	38,400	60,000	2		1	$25,000					To be built. $10,000 paid by Northampton County, also land.
19. Erie		96,000									Stations are absolutely necessary, but no provision made.
20. Farrell	15,750	17,000									Never brought up, but should be. No one started ball rolling.
21. Franklin	10,000	10,000									One in house donated by Red Cross.
22. Greensburg	18,013	19,000									No interest taken.
23. Harrisburg	77,117	80,000	3	$6,000							$22,000 appropriated and $22,000 by Dauphin Company for station.
24. Hazelton	32,277	3,400									No effort made.
25. Jeannette	10,627	10,627									
26. Johnstown	67,000	75,000									Will have to take up matter soon. 1 at city hall. Stations in dept. stores.

27. Lebanon........	34,563	34,563									No finances.
28. Lost Haven.....	8,557	8,557									Lack of interest 1920. Lack of funds 1921-22.
29. Mahanoy City.		18,000									No suitable site.
30. McKees Rocks..	16,713										No necessity.
31. McKeesport.....											Bond issue authorized. Nothing doing as yet.
32. Meadville.......											
33. Monongahela....	8,775	10,000							4		At city hall.
34. New Castle.....	44,938	46,000							1		$3,500 Appropriated. Received $339.59; expended $3,163.50.
35. North Braddock..........	14,928										
36. Oil City........	21,274	22,000							1		At city hall.
37. Old Forge.......											Sufficient public houses.
38. Phoenixville....	10,484	10,000									Lack of funds.
39. Pittston.........											No funds. Bond issue rejected by the people at May primaries.
40. Pottsville.......	21,000	22,000									No funds. (Effort made 1920, but failed.)
41. Pottstown......	17,500										No funds.
42. Reading........	107,784		1	$26,000	1	$41,000	2	$67,000			
43. Sharon..........	21,747	23,000							1		Business district. City now comtemplating stations
44. Steelton........	13,894	14,214									
45. Sunbury.......											
46. Swissvale.......	10,980	12,000									
47. Titusville.......		8,500	2								Under construction. Cost $1,100.
48. Uniontown....	16,000	17,000									Ladies rest room and comfort station at city hall.
49. Williamsport...			3				2		4		One at Lycoming County court house.
50. Wilkesbarre....	76,000	78,000	1	$20,000							Station constructed 1915. No city should be without a station.
51. Woodlawn......		13,000									No great demand.
52. York...........	45,000										Has been agitated a number of years but has never materialized.
53. Washington.....		25,000									
Philadelphia....	1,800,000	2,000,000	14	$140,000			1	17,000			Underground

REPORT OF THE COMMITTEE ON STREET CLEANING, REFUSE DISPOSAL AND SNOW REMOVAL

A. Prescott Folwell, Chairman, New York City

(Mr. Folwell prefaced his report with the following remarks.)

The Committee had expected and hoped that we would have this year a report from Mr. Fairtrace, on "Equipment for Street Cleaning." Mr. Fairtrace, who is City Engineer of Dallas, has been making investigations for approximately a year, probably more, and during the past year or more has been actually trying out street cleaning equipment of various kinds and has some very interesting data. Unfortunately, he has been called upon to serve in a dual capacity in the City, on account, I believe, of the protracted ill-health of one of the Commissioners, so that he informs me that he had absolutely no time to work up the data; and in fact, as I remember, he told me in a personal conversation that his doctor ordered him to abstain from business for a time to avoid nervous prostration. Under the circumstances, I believe the Society will pardon that Committee for not bringing in a report this year. We hope that the report next year will be invaluable for the additional data that will be available by that time.

The aim in this Sub-committee work was to obtain this year as complete data as possible concerning present conditions thruout the United States as to street cleaning and refuse disposal, with the idea that we could pass this review of existing conditions to the committee of the succeeding year, thus enabling it to act more intelligently in obtaining more particulars concerning the more interesting features, giving the high points and the low points, which should receive more thoro investigation.

For several months the investigation has been going on by means of a questionnaire and follow-up letters and the replies have kept coming in until about three weeks ago, which did not give much time for tabulating and digesting the information. Combined with this is the unfortunate fact that the Chairman's assistant, who was just starting in with the work, made up her mind to adopt matrimony as her next venture in life and that halted the compilation of the material to some extent.

We have, however, tabulated the information from about 150 cities. We hope to have information from 250 tabulated and ready to publish in the proceedings before they go to press, but they were not available in time for this report. We have data concerning collection from 150 of these cities. I will not attempt to read these figures, of course, because you would not get very much from the reading of them at this time.

I think progress has been made in the methods of collection adopted in the different cities. I think ten years ago things would have been reversed—two-thirds would have reported their methods as unsatisfactory and only one-third as fairly satisfactory.

THE REPORT

The report of this committee is confined this year to the presentation of information as to the present status of refuse collection and disposal in about two hundred and twenty-five cities of all sizes and in all sections of the country. It had been hoped that the Sub-committee on Street Cleaning would be able to give a report on the very interesting investigation and trying out of street cleaning machinery made by him during the past two years, but this has been prevented by a pressure of his official duties increased beyond all precedent during the past year.

The refuse collection data are given in the following report of Sub-committee B.

Data Concerning Refuse Collection in Cities

During the past few months information has been obtained from more than two hundred cities concerning the methods employed by each in collecting and disposing of refuse and the satisfactoriness of the methods in use. Replies to inquiries have continued to straggle in, some in response to second requests, up to only a few weeks ago, and because of this the tabulation has not been completed in time for this convention, but will be for publication in the Proceedings. Sufficient has been done, however, to permit giving a summary of some features of collection in 150 of the cities.

The cities include all sizes, from a thousand to a million population, and are distributed thru almost all the states of the Union. The replies from some are very meager, from others are quite

STATISTICS OF GARBAGE AND

(Abbreviations given on

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Alabama									
Fairfield	G	City force	Mules—wagons		6	2	6	2	
Selma	GR	City force	Carts						
Arkansas									
Helena	GAR	Private							$26.00
Pine Bluff	R	Private	Trash truck						
California									
Alameda	G	Private							6.00
Glendale	GAR	Mun. col.							G—4.00 R—1.00—25 gal
Long Beach	GR	Mun. col.	2 tractors, 10 trailers, 6 teams						
Napa	G	Private				1 or 2		1 or 2	6 or 12
Oakland	AGR	Private				1		1	6.00
Richmond	GR	Priv.—bonded			3	1	3	1	6–9.20
Sacramento	GAR	Mun. col.			1 or 2		1 or 2		6–9.00
Stockton	C	Priv. 3 Co's							9.00
Upland	GR	Private							
Colorado									
Montrose	AR	Individ.							
	G	Individ.							
Salida	G	Priv.—licensed							
	R	Individ.							
Connecticut									
Bridgeport	GA	City force	Truck, horse-trailer	G—yard A—curb		1		1	
Bristol	GA	City force	G—tank wagon, A—city teams	A—curb		2		1	
Hartford	G	¾ priv.—¼ city	4½ yd. dump wag.	Curb	6	1	6	1	
	AR	City force	Dump wagons	Curb	6	1	6	1	
New Haven	G	¼ city—¾ priv.	Teams	Yard		5 da.		5 da.	
New London	G	City force			6	2	6	2	
	AR	City force			6	1	6	1	
Sou. Manchester	G	Individ.							

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[1] Revenue does not cover cost of sorting

REFUSE COLLECTION AND DISPOSAL

pages 234 and 235

				DISPOSAL OF REFUSE			
Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
$3,780.00	5,700	135,600 C.	V. Satis.	C	Burned on dump		V. satis.
			G. Dis. unsat. Incin. prop.	G	Dumped		Not satis.
			Satis.	GAR	Dumped outside—burned		Satis.
	20,000		Unsatis.	R	Dumped over river bluff		
			Unsatis. Incin. prop.	G	Sold hog raisers		
				R	Dumped		
				G	Sold hog ranch		
				R	Paper baled—rest burned		
$4.50 per T.			R-Col. unsatis. Incin. prop.	G	Sold hog raisers		Unsatis.[1]
				R	Sorted & sold or burned		
			No chg. contem.	GR	Dumped on land		Unsanitary
	216,000		No chg. contem.	C	Dumped on tide flats	$20,000	Cheap—Satis. except flies & rats
$100 pd.city			Satis.	C	Dumped & burned		Unsatis.—unsightly—bad odors and rats
			Not entirely satis.	G	½ incin., ½ dumped & buried	13,500	Contemplates dumping all refuse and cover with earth
			Fairly satis.	GR	Dump on land outside; paper sold		
			Irreg. coll.	G	Hogs by farmer		Fairly satis.
				R	Dump in wash		
			Fairly satis. chg. prop.	G	Hogs by farmers		Fairly satis.
			Fairly satis.	GR	Dumped on land		
-45,369.54		A-16,255 wag.	V. few complaints	G	Munic-red. plant	71,790	Satis.
-47,197.18		G-13,807 T.		A	Dumped		
- 5,986.00				G	Hogs by contractor		
- 996.00	14,000						
26,008.86	140,000	23,963 c. y.	Satis.	G	Fed to pigs		
191,368.92		286,695 c. y.	Satis.—no change contem.	AR	Dumped on land		
37,149.72	155,000	13,000 T.	Satis.	G	Fed to pigs		No chg. contem.
9,000.00	25,000		More econ. equip.	G	Fed to pigs	2,500 net	
25,000.00				AR	Dumped on land		
				G	Pigs by farmers		
				AR	Dumps		

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Connecticut—Con.									
Stratford	N	Individ.							
Wallingford	G	Individ.	Wagons						
Florida									
Clearwater	GR	City force	Light truck						
Fort Myers	GR	City force	2 trucks—4 men			2		2	
Gainesville	GR	City force							
Jacksonville	GR	City force	Truck—team						
Sanford	G	City force							
Georgia									
Griffin	GR	City force							$4.00
Idaho									
Boise City	G	2 contr.			5	3	6	2	
	R	Private							6–12
Pocatello	G	Contr.	4 teams for city; 1 for hotels & rest.						
Illinois									
Champaign	G	Private		Part of city		2		2	18.00
Chicago Heights	GR	City force	Teams—trucks						
East Moline	GAR	Contract							
Edwardsville	G	Individ.							
Evanston	G-1	City force	6 wag.—1 truck	G. cans		2+		2+	5 1 can
	G-2	City force	2 trucks for cans	G. cans		2 da.		2 da.	3 addl.
	AR	City force	Teams & trucks			2			
Galesburg	GR	City force	3 wag.—2 carts						
Glencoe	GAR	City force				3		3	18–72[2]
Joliet	GA	City force							
Kewanee	GR	City force							
	A	Individ.							5.00
Marion	GR	Priv.—licensed							
Murphysboro	G	City force	Tank wagon			6		6	
Quincy	G	Contract							
	AR	City force							
Indiana									
Bedford	G	Contract	2 teams			2		2	
Elwood	GAR	City force		Yard or alley		3		2	

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[2] Price charged depends on size of house

Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	DISPOSAL OF REFUSE			
				Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
	12,000			GAR	Individ. dis.		V. unsatis.
	14,000		Coll. uncer. outfit unsanitary.	GAR	Individ. dis.		
7,200.00			Satis. to pub.	C	Dumped and burned		Satis.
350.00	4,500		Satis.	GR	Incin.—Dump & burn		
			Motorizing eqpt.	G	Incin. and hogs		
				GR	2 incin.—dump in swamps		
				GR	Dumped on land		
			Satis.	GR	Incin. & city farm		Satis.
$406 pd.city				G	Hogs by contr.		
$6,552.00			Satis.	G	Hogs—dumped—burned	$360	
			Fairly satis.	G	Buried		Fairly satis.
				AR	Dumped on land		
4,000.00	20,000		Will enlarge incin.	G	Incin.		
				AR	Dumped in quarry		
5,000.00	8,000		G—unsatis.	G	Hogs by contr.		
			Incin. prop.	R	Dumped on pub. prop.		
6,000.00			Satis.				
				G	Incin.		
				A	Surfacing streets		
				R	City dump		
Wag. 5.50—Cart 4.50			Very satis.	GR	Incin.		V. satis.
			No change contem.	G	Hogs by farmer		Satis.
				A	Road bldg.		
				R	Dumped & burned		
				G	Incin.		
				A	City dump		
3,409.00			No chg. contem.	G	Dumped outside		
				AR	Dumped in city		
			Unsatis.—coll. irreg.	GR	Dump on city land		V. unsatis.
3,000.00			Satis.	G	Dump on city land		Satis.
12,400.00			Unsatis.	G	Hogs by contr.		Unsatis,
				AR	Dumped on land		
				G	Removed by farmers		
4,511.00	12,000		Fairly satis.	GAR	Buried—dumped		Only fairly successful

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Indiana—Con.									
Fort Wayne......	G	Contract	Tight steel tanks	Yard	6	2	6	1	
Lafayette........	G	City force	4 covered wag.			2		1	
Portland..........	G	Contract							
	A	City force			6	1	6	1	
Richmond........	G	Contract[3]							
	AR	City force							
South Bend......	G	City & priv.		Alley					
Terre Haute......	G	Contract							.75
Wabash...........	G	City force	Wagons			1		1	
West Lafayette...	G	Contract							
Iowa									
Ames.............	G	Private				3		3	$12.00
Cedar Rapids....	G	City force	Truck & trailers			2		1	
Centerville.......	G	Individ.							
Charles City......	G	Contract							
Cresco............	G	Individ.							
Creston...........	G	Individ.							$10–12
	A	City force							
Davenport.......	GAR	City force							
Dubuque.........	G	Contract							
	A	City force							
Eagle Grove......	G	Individ.							$5.00
Keokuk..........	G	Individ.							
Muscatine........	G	Contract							
Spencer...........		Individ.							
Kansas									
Chanute..........	G	Individ.							
El Dorado........	GR	Contract				2		1	24.00
Independence....		Non-official	Zinc lined wag.		6	2	6	2	12.00
Salina............	GAR	Priv. individ.				2		2	24.00
Kentucky									
Ashland..........	GAR	Contract							
Louisiana									
Lake Charles.....		Individ.							
New Orleans.....	GAR	Old—contract New—tractor, trailer	Dump cart Trailers—rem. cont.		6	6	6	6	

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[3] Garbage collection by city force for years 1911–1921.

[4] Area of city 1½ sq. mi.

Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	DISPOSAL OF REFUSE			
				Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
41,472.00			Farmers displeased	G	Pigs by contr.		
7,762.00	23,000			CG	Dump—Incin.		
500.00				A	Filling streets unimproved		
5,500.00	26,000			GAR	G—Incin.		
24,000.00					AR—Dumped on low land		
15,000.00		60%		G	Hogs by farmers		Only a makeshift
			Not freq. enough	G	Pigs by contr.		
2,000.00			Satis.	G	Pigs by farmer		Satis.
720.00	5,500		Satis.	G	Pigs by contr.		Quite satis.
	11,000						
		10% of res.		G	Pigs by cont.		Fairly satis.
14,783 00		5400 T.	Object to river dis.	G	Dumped on river bank		Seriously objectionable
				G	Stock by farmers		
				G	Stock by farmers		
			Satis.	GAR	To hogs—buried		
	8,500			G	Hogs by farmers		Quite satis.
				A	Roads in parks & cem.		
30,000.00				GAR	Sanitary fill	$3,500	V. satis.
12,000.00	40,000		Unsatis.	GAR	G—priv. red. plant AR—on low lands		
	5,000			G	Dump on city land		
				G	Buried by priv. coll.		
				G	Hogs by contr.		
				AR	City dump		
				G	Hogs by farmers		
				G	Removed by farmer		
	11,000		G. coll. irreg.	G	Hogs by cont.		Not entirely satis.
				R	City dump		
	12,000			GR	Sold to farmers		Satis.
			Unsatis.	G	Hogs by farmers		V. unsatis.
				AR	City dumps		
			Unsatis.	C	Incin.	$2,000	Not satis.
				R	City dump	900	
			City coll. cans	G	Hogs by farmers		
				C	City dump		
$3-$4 ton				C	Dumped & burned		
					Incin. being built		

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Maine									
Augusta	G	Private							
	AR	Private City in bus. cent.							
Massachusetts									
Beverly	G	Contract							
	AR	City force							
Brockton	G	City poor dept.	1 truck—16 teams		6	1	6	1	
	AR	City health dept.	1 truck—8 teams	Street	3	1	3	1	
Cambridge	G	City force	Wood carts		6	3	6	2	
Fall River	G	Contract	Wagons						
	AR	City force	Horse—tractors contem.						
Fitchburg	G	Contract							
	AR	City force				⅓		½	
Greenfield	G	Contract							
Holyoke	G	Contract							
	AR	City force							
Lynn	GAR	City health dept.							
Marlboro	G	Private							
Middleboro	G	Private				1		1	Nil
	R	Contract				½		½	
New Bedford	GAR	City							
North Adams	G	Contract							
N. Andover	G	Private							Nil
	A	City				⅙		1	
Orange	G	Contract							
Peabody	G	City poor farm							
	AR	Contract							
Waltham	G	City	6 teams						
	AR	City	Teams—truck in sub.						
Webster	G	Private							
West Newton	G	Contract							
	AR	City							
Worcester	G	City (overseer poor), priv.—36 col.	22 teams—2 trucks						
Michigan									
Alma	G	Contract—farm							
	AR	City			6	2	6	2	3.12

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[1] Area of city 72 sq. mi.

				DISPOSAL OF REFUSE			
Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
			Satis.	G	Fed to pigs		Satis.
				AR	City dumps		
$4,200	23,000		Satis.	G	Pigs by contr.		Satis.
5,500				AR	Filling swamp for parks & streets		
38,000			Satis. want 2 coll. pr. wk. in sum.	G	Hogs at city home	22,400 net	
38,000							
80,000			No chg. contem.	G	Sold hog farmers	15,000 profit	
79,000			Satis.	G	Hogs by contr.		Satis.
85,613			Satis.	R	Filling low lands		
	41,000		Satis.	G	Hogs by farmers		Satis.
16,065.25				AR	Filling low land		
3,000				G	Taken by farmers		
8,210				G	Taken by farmers		
87,021				AR	City dump		
				G	Sold for hogs		
				AR	Private dump		
Nil	18,400			G	Fed to hogs		
360				R	Public dump		
			Satis. though expensive	G	Incin. or red.		
3,150	22,282			AR	Filling low land		
Nil			Fairly satis.	G	Hogs by contr.		Fairly satis.
2,100			Satis.	G	Coll. by farmers		
				A	Dumped on land		
			V. satis.	G	Burned on pub. dump		Satis.
			Satis.	G	Fed pigs on city farm		
4,975				AR	City dump		Satis.
15,500	31,000			G	Sold to farmers	3,500 profit	
22,000				AR	Dumps in swamps for park		Unsatis.
				G	Removed by farmers		Satis.
24,000	47,000	4,919T	Satis.	G	Fed to hogs		Satis.
55,500		50,000T		AR	Dumped on land		
35½¢ cap.			Quit priv. col.	G	Pigs on poor farm		
2,000	8,000			G	Hogs by contr.		V. satis.

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Michigan—Con.									
Ann Arbor	G	Contract							
Detroit	G	City	Wag.—trucks[4]—rail						
	AR	City	337 teams—38 trucks —780 men						
Flint	G	City				2		1	
Holland	G	Private	Tank wagons	Yard	6	1	6	1	2.60
Niles	G	Private							13.00
Owosso	G	Private				3		3	12.00
Pontiac	G	Contractor	Trucks		6	1	6	1	
Port Huron	G	Individ.							
	AR	City							
Sault Ste. Marie	GAR	Individ.							
Sturgis	G	Contract							
Minnesota									
Brainerd	GR	Private	Light open truck						14.00
Ely	GAR	City	Tight 2½ yd. wag.	Alley	6	3	6	3	
Fairmont	GAR	Individ.							18.00
Little Falls		Individ.							
Minneapolis	G	City							2.60
Pipestone		Individ.			6				
Willmar		Individ.							
Mississippi									
Hattiesburg	G	Individ.							
	R	City							
Natchez	GR	City	4 carts		6	1	6	1	
Missouri									
Jefferson	R	City							
Joplin	G	Private							None
Sedalia	G	Priv.—city							
	AR	Individ.							
Montana									
Havre	G	Private							1.35

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[4] Wagons dump into trucks at sub-stations. Removable bodies loaded on cars at station and taken by rail reduction plant outside city.

Per $1000 valuation.

Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	DISPOSAL OF REFUSE			
				Kind of refuse	Method of disposal	Cost per year	Satisfactoriness.
15,200			V. satis.	G	Hogs or buried by contr.		V. satis.
5.59 ton				G	Red. 20 mi. out		
1.65 yd.				AR	City dump		
$75,231	100,000		Satis.	G	Hogs on city farm		Entirely satis.
			Satis.				
			Unsatis.	G	Hogs & geese by farmers		Not v. satis.
	14,000		V. satis. col. wholly resp.	G	Hogs by contr.		V. satis.
				AR	City dump		
12,500	35,000		Not v. satis.	G	Hogs by contr.		
24¢[5]				G	Hogs & chickens by farmers		V. satis.
				A	On pub. dump		
			Coll. unreliable, cost high	GAR	On pub. dump		Not satis.
1,480	6,500		V. satis.	G	Hogs by contr.		
		62 Res.	Farmers serve hotels	C	City dump		
$2800 wages & teams	5,000		City fur. 200 6-gal., 350 8-gal., 200 12-gal. cans. V. satis.	GAR	City dump		Satis.
	4,660			AR	Burned on city dump		
				G	Hogs by farmers		
			V. little compulsion				
				G	Incin.		New plant contemplated
			V. unsatis.	G	Fed stock by farmers		
				G	City dump		
4,800				G	Incin. & to farmers		
			Not entirely satis.	R	Incin. or dump		
3,900	12,00		No chg. contem.	GR	Dumped in river		
				A	Dumped in bayous		
				G	Hogs by contr.		
			Coll. careless & incompetent	G	Hogs by farmers		
				R	$20,000 Incin.		
				G	Hogs by farmers		
				R	City dump		

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Nebraska									
Fremont	G	Private				1		1	9.00
Hastings	G	Contract							12.00
	AR	Individ.							
Lincoln	GAR	Private							3.60
Omaha	G	Contract							
	AR	Individ.							
Nevada									
Winnemucca	G		Wagons						
New Hampshire									
Dover	G	Individ.							
	AR	City							
Keene	GAR	Individ.							
Laconia	GAR	City		Curb		1		1	
New Jersey									
Atlantic City	G	Contract							
	AR	City	Wagons						
Freehold	G	Contract				2		2	
	AR	Individ.							
Garfield	G	Contract							
Irvington	GA	City			6	3	6	3	
Long Branch	G	Contract							
Millville	GAR	Individ.							
Montclair	G	City	2½-ton trucks	Yard		3		2	
	A	City	3½ cu. yd. wag.	G.wrapped		1		3	
	R	City	7 cu. yd. carts		1	1	1	1	
New Brunswick	G	City		Wrapped		2		1	
	AR	City	Dump wagons			1		1	
Newton	G	Individ.							
Paterson	GAR	City	Trucks						None
Phillipsburg	GA	Contract							

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[1] Area of city ¾ sq. mi.

[2] Area of city 3940 acres.

Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	DISPOSAL OF REFUSE			
				Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
			V. satis.	GR	Fed hogs—City dump		V. satis.
	12,000			G	Buried by contr.		
				A	Sts., alleys & lots		
		45,000 T.	Sub. neglected	G	Fed stock & city dump		
				AR	City dump & filling lots		
79,000			Former cont. coll. irreg.	G	Hogs by contr.		
				AR	City dump		
				C	City dump		
			Fairly satis.	R	Incin.		
				G	Farmers		
				A	Dumped by city		
			Satis. to most	G	Fed hogs & incin.		
				R	Incin.		
7,000		5400 c. y.	No chg. contem.	G	Fed hogs		
				R	Dumped		
				A	Grading & covering dump		Generally satis.
139,900				G	Incin. by contr.		
80,000				AR	Dumped		
3,150	[1]5,000			G	Hogs by cont.		
				AR	Dumped on boro land		Fairly satis.
				G	On low land & covered		
14,000 (c)			No chg. contem.	GA	On low land—covered		V. satis.
			V. unsatis.	G	Pigs by contr.		
			V. unsatis.	G	Hogs & chickens by farmers		V. unsatis.
				AR	Filling low lands		
30,000 (c)	[2]31,000	7280 c. y.		G	Sold for hogs		
35,300 (c)			Entirely satis.	A	Fillingstreets—low land	$2,000 profit	
20,200		2600 wag.		R	Dumped & burned		
8,242 (c)		3029 c. y.		G	Fed pigs & incin.		
26,600 (c)		40,978 c. y.		AR	Filling low ground		
		20%	Unsatis.	G	Part fed to pigs		Unsatis.
			Satis.	GR	Incin.		
				A	Dumped on fill		
				G	Hogs by farmers		
				A	Dumped on low land		

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per ear per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
New Jersey—Con.									
Rahway	G	City	2 dump wag.			1		1	
Spring Lake	GAR	Contract							
Summit	GAR	Contract		Yard or cellar					
Bergenfield	GAR	City							
Westfield	GA	Private							18.00
New York									
Albany	G	Cont., bus. sec.							
	G	Individ.							None
Auburn	G	Contract							
Buffalo	G	City	5 yd.-wag., trailers	Rear	6	2	6	1	
	A	City	5½ yd. trailers & wag.	Rear					
	R	City	18 yd. (round up 24 yd.)	Rear					
W. Carthage Carthage	GAR	Individ.							12.00
Glens Falls	GAR	Private							G. 50¢—A. 20 a can
Gloversville	G	Contract							
Herkimer	G	Contract							
Hornell	G	Private							10.20
Hudson	GA	Contract							
Little Falls	G	City		Res.—can at rear door	2	1	2	1	
Mineola	GR	Contract							
Niagara Falls	GR	City	10 2½-yd. wag., 11 5-yd. trucks		6	2	6	2	
N. Tonawanda	GA	Individ.							
Oneida	GA	Individ.							39.00
Oswego	GAR	Private							G.$5; A.35¢ bl
Poughkeepsie	G	Contract							
	A	City							
Schenectady	GA	City	Wagon	Bk. door—cellar					
Syracuse	GAR	City							
Watertown	G	Contract							

[1] Area of city 850 acres.

Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	DISPOSAL OF REFUSE			
				Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
6,800				G	Dumped on low land		Will buy incin.
			Not satis.	G	Hogs by contr.		Net entirely satis.
				AR	Dump		
29,400			Reasonably satis.	G	Hogs by farmers		Not satis.
				A	Fill streets & land		
				R	Dumped & burned		
1,800	4,000						Satis.
			Fairly satis.	G	Sold to farmers		
				AR	Filled on low land		
4,700	[1]			G	Hogs by farmers		
				AR	Dumped on low land		
				G	Buried in trenches		Satis.
				AR	Dumped on low land		
2.15 pr. yd.			Satis.	G	Fed pigs by city		
.695 pr. yd.			Satis.	A	Numerous dumps		
.59 pr. yd.				R	Sorted, sold & burned		
	5,986		25% use sys. Nuisance	G	Pigs by farmers		Only 25% removed
			Very unsatis.	G	Fed to pigs		V. unsatis.
			Satis.	G	Dumped on city land		
			Satis.	G	Dumped on river bank		Satis.
				G	Pigs by contr.		
				A	City dump		
7,700.00	12,000		Satis.	G	Pigs by contr.		
				A	Dumped on land		
3,000.00	14,000			G	Pigs by contr.		
2,500.00	3,000		Unsatis.—dump odors	C	Dumped outside village		
	60,000			C	Dumped in Niagara Rapids		
	100,000						
			Satis.	GA	City dump		Satis.
			Considering chg.	G	Fed pigs & dumped		
			Considering better facilities	G	Pigs by contr.		
				A	Filling low land		
8¢ bbl.				G	Mun. red. plant		
1.50 pr. cap.			R. dis. unsatis.	G	Mun. red. plant		V. satis.
				AR	City dumps		Incin. contem.
				G	Pigs by contr.		

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
North Carolina									
Durham	GAR	City							
Fayetteville	G	City							
Goldsboro	GAR	City	6 carts			2		2	
Greensboro	GR	City	6 wag.—3 trucks		6	1	6	1	R. $1 load
North Dakota									
Bismark	GR	Contract							
Fargo	G	Private				1		1	12.00
Jamestown	GR	Private	Truck						8.00
Mandan	G	City	1 team			4		4	.50
Valley City	GR	City							
Washburn	G	Individ.							
Ohio									
Akron	G	City force							
	AR	Private							4.00
Alliance	G	Private							
Ashtabula	G	Private							10¢ c. f.
Bucyrus	GAR	City				2		1	
Canton	G	City							
Cincinnati	G	Contract							
Columbus	GR	City	24 teams						
Dayton	GAR	City	G. ¾-T. tank wag.		6	1	6	1	None
Delaware	G	Individ.							
Elyria	G	Private							
Fostoria	G	City							25¢–$2 coll.
Lancaster	G	Individ.							
Lima	GAR	Individ.							
Niles	GAR	Individ.							
Urbana	G	Private				1		1	5¢ pr.cap.—25 pr.coll.
Van Wert	G	Farmers							
Westerville	G	Individ.							

				DISPOSAL OF REFUSE			
Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
				G	Pigs by farmers		
				A	Filling streets		
				R	Incin.		
3,990	12,000	2100 tons		GR	City dump & burned		
14,000	7,102		Will move incin. not satis.	G	Burned in incin.	2 men	
				A	Filling streets		
2,000			Dump ground unsatis.	GR	City dump	900	Unsatis.—crematory desired
			V. unsatis.	C	Dumped outside city		V. unsatis.
	6,627		Satis.	C	City dump	300	Satis.
425.00			Satis.	G	Dumped outside city		Thoroly satis.
750.00	5,000		Satis.	GR	City dump—burned	600	Satis.
	600			G	Dumped in river		
				AR	Filling streets		
9.95 ton		14,000 T.	Unsatis. no. coll. & cost	G	Sold for pigs		Satis.
				AR	City & private dumps		
5.25 pr.cap.			No chg. contem.	G	Private col.		
			No chg. contem.	G	Fertilizer by col.		
2,000			Difficult to keep proper cans	G	City hog farm		
				AR	City dump—burned		
			Satis.	G	Sold hog raisers		Satis.
				G	Red. company		
R. 38¢—		R. 160,000 c.y.	Satis.	R	Dumped		
G. 35¢ pr. cap.		G. 23,342 T.		G	Mun. red. plant		Satis.
G. 2.98 pr. ton				G	Mun. red. plant		
				AR	City dumps		
				G	Hogs by farmers		
				AR	Dump		
1.85 pr.cap.			V. satis.	G	Pigs & red. plant		V. satis.
				G	Pigraisers—dumps		
			V. unsatis.	G	Farmers		
				AR	Dump		
				C	Public dump		
			No chg. contem.	G	Hogs by contr.		
				AR	City dump		
				G	Pigs—city dump		
				G	Pigs by contr.		
				AR	City dump		

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Ohio—Con.									
Wooster	G	Contract							6.00
Youngstown	G	Contract							
Zanesville	G	City	3 wagons						
Oklahoma									
Enid	GR	Private							3.00 ap
McAlester	R	Contract							
Oklahoma City	GR	City							3–6
Oregon									
Astoria	GR	Private							18.00
Eugene	G	Individ.							
Klamath Falls	G	Contract							3.00
Pennsylvania									
Altoona	G	City				2		1	G. 13687; R.15
Berwick	GA	Private							6–9
Bethlehem	GAR	Private							7.80–18.20
Braddock	GR	Private							
Carlisle	G	Contract							
Clairton-N. Clairton-Wilson	GAR	City	1 1½-ton truck						
Duquesne	GAR	Private							5.10
Elizabethtown	GAR	Private							
Ellwood City	G	City	Wagon—trucks	Wrapped & in can					6–12–18
Erie	GR	City	2 2½-ton trucks						
Franklin	G	Private							Res. 40¢ per m
Greensburg	G	Private							
Hanover	G	Private							
Hazleton	GA	Private							20¢-25¢ bbl

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[1] Area of city 1,260.4 acres.

[2] Also buried in trenches and dumped.

Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	DISPOSAL OF REFUSE			
				Kind of refuse	Method of disposal	Cost per year	Satisfactor'ness
			Satis.	G	Pigs by contr.		Satis.
			No chg. contem.	G	Pigs by contr.		
				AR	City dumps		
5, 300			Fairly satis.—irreg. summer coll.	G	Incin. & pigs		Fairly satis.
			No chg. contem. No coll. system	G	Hogs by farmers		
				AR	City dump		
			Fairly satis.				
				G	Hogs by farmers		
				R	City dump—burned		
			Satis.	GR	Burned in gulch		Not satis.–fumes disagreeable
				G	Pigs by farmers		
				R	Dumped—burned		
			No chg. contem. unsatis.	GR	Dumped—burned by cont.		Not satis.
	60, 000		Satis.	G	Mun. incin.		Satis.
	12, 000		Satis.	G	Dumped on river bank		Not satis.
			Fairly satis.	G	Pigs by farmers[2]		V. satis.
				AR	City dump		
6.50 pr. ton	20, 000	6 T. pr. d.	Satis.	GAR	Incin.—Boro dumps		Satis.
1, 945.60	11, 000			G	Pigs by contr.		Satis.
				AR	Dump		Not satis.
4, 200	14, 000		Satis.	G	Mun. incin.		V. satis.
	[1] 20, 000		Unsatis.—no system	G	Mun. incin.		Not satis.
				AR	Pub. dump		
			Satis.	G	Buried & to pigs		Satis.
				AR	Public dumps		
3.23 ton			Do not cover expenses	G	Incin.		
				AR	Dump & incin.		
		G. 9823 T.		G	Hog ranch		Satis.
		R. 9707 c. y.		A	Dumped anywhere		Unsatis.
				R	Public dumps		
	13, 000			G	Pigs by farmers		
				R	Pub. dump—burned		
				G	Farmers		
				R	Sorted & incin.		
				GAR	Dumped in stone quarries		
			Unsanitary alleys	G	Dumped & fed animals		Not satis.
				A	Public dump		

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Pennsylvania—Con.									
Lebanon	GAR	Private							8.00
Lock Haven	G	Individ.							
Parkersburg	GAR	City							
Pottsville	GA	Private							
Rankin	GR	City							
Tyrone	GAR	Private							
Wilkinsburg	G	Contract	Wagons						
Williamsport	G	Private							
Rhode Island									
Newport	GR	Contract							
Westerly	G	Individ.							
Woonsocket	G	Individ.							
	AR	City	Trucks						
South Carolina									
Charleston	GR	City	Carts						
Chester	GR	City	4 wagons						
South Dakota									
Winner	G	Individ.							
Tennessee									
Cleveland	G	Individ.							
Johnson City	G	Individ.							
Memphis	GA	City	2 ton Trucks—1 cart		6	G. 2 A. 1	6	A. 2 G. 1	
Texas									
Amarillo	G	Private							
	R	City							
Beaumont	G	City	10 teams—3 trucks & trailers						$6–12
Denton	G	Private							
Galveston	G	City							
Mineral Wells	G	Private							
McKinney	G	Private							
	R	City	2 men—1 wagon						
Navasota	GR	City bus. dist.							

Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	DISPOSAL OF REFUSE Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
			Unsatis.	C	Dumped in quarries		Not satis.
			Unsatis. no chg. contem.	GAR	Buried or burned priv.		
770	2,543		No chg. except to truck	C	Public dumps		Fairly satis.
			Unsatis.	GAR	Public dumps		Unsatis.
5¢ pr. cap.			Fairly satis. no chg. contem.	G	Mun. incin.		Fairly satis.
			No chg. contem.	G	Pigs by farmers		
				AR	Filling & grading		
24,000				G	Reduction Co.		
				C	Dumped in log basins—burned		
19,250	35,255	17,196¼ T.		R	City dumps		
				G	Pigs by farmers		
15,000			V. satis.				
50,000 app.				G	Dumped in marshes		Destructor discontinued
0.40 pr. d.				GR	Dumped in gullies & burned		
	6,000						
				G	Pigs by farmers		
				R	City dumps		
			Not ideal				
			Contem. incin.	G	Pigs by farmers & in sewers		
. 39¢ c. y.				G	3 incin.		Not satis.
. 35¢ c. y.				AR	Dumped on low land		
			Unsatis.—irreg.	G	Incin. & pigs by farmers		New incin. under contr.
48,000			(Disposal also)	G	Incin.		Another incin. under contr.
				AR	Filling marsh		
				G	Dumped by contr.		
57,880			Satis. (dis. also)	GR	Incin.—dumped—burned		Satis.
			Unsatis.—germs collect—no chg.		Dump		Not satis.
			No chg. contem.	G	Pigs by negroes		
1,300				R	Incin.	$720	
				GR	Dumped		

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge Per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Utah									
Logan	GR	City bus. dist.			6		6		
Ogden	GAR	Contract	6 teams		6	6	6	6	None
Vermont									
Barre	G	Individ.							
	R	City	Truck & trailer			Mo.		Mo.	
Springfield	G	Individ. cont.							
Virginia									
Lynchburg	GA	City	Horse-drawn eqpt.						
Norfolk	GAR	City			6	3	6	3	
Portsmouth	GAR	City	Dump carts						
Richmond	G	City				3		3	
	AR	City				1		1	
Roanoke	GAR	City							
Washington									
Aberdeen	G	Contract							
Chehalis	GAR	Garbage comm.							
Seattle	GAR	City	Wagons	Hotels & rest.					
	G	Contract	Tight wagons		6		6		
Spokane	GAR	City							
Walla Walla	G	Private							
	AR	City							
West Virginia									
Bluefield	G	Individ.							
Parkersburg	G	Contract							
Wisconsin									
Appleton		Individ.							
Baraboo	G	Private							$10.00
Fond du Lac	GA	City				2		1	
Green Bay	G	City	Dump truck			6 mo.		6 mo.	4.00[6]
	AR	City	6 dump wag.						
Janesville	G	Contract	Wagons		6	3	6	3	
Kenosha	GAR	City	4 trailers—4 trucks 6 horses						

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[6] Charge for permit.

				DISPOSAL OF REFUSE			
Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
$5 a day				C	City dump		
$11,000	35,000		V. satis.	G	Pigs by contr.		
				R	Dumped in holes		
			No chg. contem.	G	Pigs & hens		
				R	City dump		
750	10,000			A	Spread on clay roads		
	5,800			G	Pigs by contr.		
20,000			Entirely satis.	G	Incin.		
			Contem. no chg.	G	Sold for pigs		
				A	City dump		
				R	Incin.		
			Fairly satis.—summer bad odor	G	Incin.		Satis.
				AR	City dump		
			Chg. dept. of street clg. to D. P. W.	G	Incin.		
				AR	City dumps		
			Satis.	GR	Incin.		
37,641	51,000			A	City dumps		
				GR	Dumped—burned		
			Fairly satis.	GAR	Dumped & burned		Fairly satis.
Bus. 18— Res. 2.50							
534,100	315,000		Satis.; cost high	C	Sanitary fill		
			Desire free coll.	C	3 incin.		
4,200			Unsatis.—contr. slighted—complaint of smoke	G	Fed pigs		
7,000				AR	Dumped & burned		
			Plan system of coll.	G	Pigs by farmers		
7,400			Fairly satis.—eqpt. inadequate	G	Pigs by contr. & farmers		Fairly satis.
				AR	City dump		
				G	Pigs by farmers		
				G	City dump		
				A	Streets		
			G. unsatis.—bad odors	A	Streets—low land		Odors objectionable
				G	Park property		
			Apparently satis.—no chg. contem.	G	Fed to pigs		
				AR	Dumped in slough		
7,000				G	Pigs by contr.		
40.608 46	40,472		V. satis.—cost incl. depreciation	G	Dumped behind breakwater for park		V. satis.

CITY	COLLECTION OF REFUSE								
	Kind of refuse	Collection by	Using	Receptacles taken from	Number of collections per week				Charge per year per residence
					Summer		Winter		
					Bus.	Res.	Bus.	Res.	
Wisconsin—Con.									
Lake Geneva	GAR	Private							
Milwaukee	G	City							
Racine	G	City	Wag.—trucks—trailer						
Shorewood	G	Contract		60-lb.[7]		1 & 2 mo.		0	6.00
	A	Contract						1	
Wisconsin Rapids	GAR	City	2 teams—4 men		1	2	1	2	
Wyoming									
Cheyenne	GA	City							
Sheridan	G	Individ.							75¢ c.y. can
	AR	Scav.							

[7] Metal container.

Abbreviations: A—Ashes; App.—Approximately; Bus. Dist.—Collections made in the business district; C—Can; Cap.—Per capita; Cem.—Cemetery; C.f.—cubic foot; Chg.—Change; Col.—Collectors; Coll.—Collection; Comm.—Commission; Contem.—Contemplated; Cont.—Collection made under contract, whether public or private; Contr.—Contractor; D—Day; Dept.—Department; Dis.—Disposal; Eqpt.—Equipment; G.—Garbage; Gal.—Gallon; Incin.—Incinerator; Indi-

complete, including, for each of the three ordinary classifications of refuse, information concerning who makes the collection, the kind of vehicles used, where receptacles must be placed, the frequency of collection in both summer and winter, the charge to citizens or cost to the city, the amount of refuse collected, the population and area of the city, and the satisfactoriness of the service, changes contemplated, etc.

Garbage collection is performed by municipal forces in 52 communities (35 percent of the whole number), by contract and municipal payment in 38 (25 percent), by municipal arrangement and private payment in 28 (19 percent), and is left entirely to the individual in 32 (22 percent).

Ashes are collected by municipal forces in 41 communities (27 percent), by contract in 8 (5 percent), by private payment in 7 (5 percent), and is left to the individual in 94 (63 percent).

The figures for rubbish are almost exactly the same as for ashes, the collection by contract being 1 greater, by private payment 3 greater, and by individuals 4 less.

Total cost to city per year	City population	Amount of refuse collected per year	Condition and changes proposed	DISPOSAL OF REFUSE			
				Kind of refuse	Method of disposal	Cost per year	Satisfactoriness
			V. unsatis.	G	Dumped in gravel pit		V. unsatis.
5.79 pr. T.			Satis.—prop. new incin.	GAR	Incin.		V. satis.
5.22 pr. T.			Not entirely satis.	G	City incin.		
				AR	Public dumps		
5.20 pr.man				G	Plowed under land		
5,501.70	3,800		V. unsatis.—bad odors	C	Dumped low lands		Not entirely satis.
10,000				GAR	City dumps		Satis.
				AR	City dump—pigs—chickens		Not very satis.
					City dump		

vid.—Disposed of by individual householders, by contract or otherwise; Irreg.—Irregular; Met.—Metal; Mo.—Month or monthly; Mun.—Municipal; Pd. city—City sells garbage or refuse for sum named; Priv.—Private; Prop.—Proposed; Pub.—Public; R.—Refuse, combustible and incombustible; Red.—Reduction; Rem.—Removable bodies on trailers for andling at incinerator; Res.—Residence; Resp.—Responsible; Satis.—Satisfactory; Scav.—Scavenger; Sub.—Suburbs; T.—Ton; Uncer.—Uncertain; Unsatis.—Unsatisfactory; V.—Very; Wag.—Horse drawn wagons; Y.—Cubic yard.

These figures show that the municipalities pay from the public treasury for collection of garbage in 60 percent of the cases, for ashes in 32 percent and for rubbish in 33 percent.

Only about half the informants express their opinions as to the satisfactoriness of the methods in use. The terms used vary, but it is believed that most of the ideas can be classed under one of the four heads—"very satisfactory," "fairly satisfactory," "not very satisfactory," and "unsatisfactory." We find that 29, or 38 percent, consider their methods very satisfactory; 21, or 28 percent, fairly satisfactory; 7, or 9 percent, not very satisfactory; and 19, or 25 percent, unsatisfactory. That is, two-thirds consider their methods at least fairly satisfactory, and one-third more or less unsatisfactory.

It is apparent that these expressions of opinion can not be used as a basis for selection of methods by other cities without a thoro study of local conditions. For example, the city manager of Waltham, Mass., believes that "The contract method of garbage collection in a city the size of Waltham is unsatisfactory at best.

We have tried this method for the past five years and the results have given general dissatisfaction. For two years the public has clamored for a return to collection by the city, which was in vogue for years previous to 1917 and which gave general satisfaction, altho far more expensive than the contract method." On the other hand, the city engineer of Ann Arbor, Mich. reports that the contract method of garbage collection "is very satisfactory. We have very few complaints due to non-collection and it is handled without any offense whatever."

The writer believes that there is probably no other branch of municipal housekeeping or public service where wise choice of methods is so dependent on local conditions as well as an intimate knowledge of the subject in all its phases, as the collection and disposal of municipal waste. Local habits as to wastefulness of food, coal, etc., grades of streets and other topographical features, climate, kind and abundance of labor available, existence of vacant lands available for dumping; these and a score of other conditions—physical, political, social and commercial—must be carefully considered and weighed each against the other if a wise choice is to be made.

MODERN METHODS OF DISPOSAL OF GARBAGE AND SOME OF THE TROUBLES EXPERIENCED IN THEIR USE

By Samuel A. Greeley, Pearse, Greeley and Hansen, Chicago, Ill.

1. General

The practice of refuse collection and disposal in American municipalities has been characterised by some well informed observers as a mess of mistakes. They see a wide variety of disposal methods in use and in some cities apparently abrupt changes from one method to another sometimes involving the abandonment of seemingly useful and expensive going plants. They see large and costly disposal works built and operated for a few years and then abandoned to gradual disintegration. The city engineer of Gary writes that "our incinerators have been out of service for seven years and would have to be rebuilt to make them serviceable." Los Angeles, after 7 years operation of a garbage reduction plant, has abandoned it (at least for the present) in favor of hog feeding. Baltimore, after a few years of hog feeding for garbage disposal, has turned again to reduction; and Buffalo, with hog feeding established for a while has recently taken bids for incineration. The large reduction plant at New York and a group of incinerators at Seattle, have all been abandoned in favor of dumping on land and at sea.

The critical observer further notes many different disposal methods in use in different cities, with reported satisfactory results. Thus at Minneapolis the garbage is burned with some rubbish, while in St. Paul it is taken to several farms for feeding to hogs. In the metropolitan district of New York, the Boro of Queens burns the garbage and rubbish, the Boro of Richmond burns mixed refuse, Manhattan and the Bronx dump the garbage at sea, Newark feeds the garbage to hogs. A short distance up the State, Schenectady, Rochester and Syracuse have reduction plants. These are situations which merit interest and consideration.

2. Fundamental Considerations.

Having these observations in mind, it becomes increasingly important to emphasize the fundamental considerations largely controlling the problem of refuse collection and disposal. If service to householders and proprietors be held of first importance, with economy of operation following closely, then the observers' perspective shows the disposal of refuse as of somewhat less importance than the collection service. If two somewhat similar cities (as for instance St. Paul and Minneapolis) have equally good collection service, it is quite possible that general satisfaction among householders can be secured with different methods of disposal. If the different disposal methods are well administered, the difference between them is largely one of annual cost.

Therefore, at the risk of repetition, let me state the four parts or phases of the refuse problem as follows:

a. The house treatment.
b. The collection.
c. The transportation or haul.
d. The final disposal.

Of these phases of the problem, the collection and transportation are the costly part of the work (on an annual basis). As the collection also orients or establishes the standard of service to houses, it merits first consideration in the development of a general plan. If the development of general plans for refuse disposal, or the readjustment of existing methods, were oriented squarely to the relative importance of these various phases of the problem, the shifts and failures, which our informed observer finds, would not so frequently occur.

Let us note, however, that recent years have marked a promising realization of the importance of collection work and the related problem of haul. Much has been accomplished thru motorization as at Los Angeles, Montclair, Minneapolis and elsewhere altho final economies are not yet established. Further progress toward economy has resulted thru the use of the tractor-trailer and the establishment of transfer stations which permit the decrease of the expensive collection haul with an increase in cheaper quantity haul.

3. Importance of Haul

Thus a review of refuse disposal practice in the light of some of the projects recently developed, particularly in the larger cities, reveals, among other things, a growing realization of the importance of haul. By haul is meant the travel of the loaded collection unit from the collection district in which the refuse is produced to the place of disposal. This item in fact links up the various phases of the refuse disposal problem from the house treatment, to the final disposal. In plain terms the gradual exhaustion of dumping grounds and disposal sites and the increasing cost of haul, have curtailed the collection service to such an extent that public opinion has come to the front for improved service. This is a situation which, if rightly turned, can greatly assist the development of improved service thru acquirement of sites, overhauling of collection equipment and construction of disposal works. With increasing costs of haul old appropriations cannot continue the collection service desired, so that betterments and economies are requisite. If nearby dumps become filled, how can the old budget carry double or triple the haul, without curtailing the service? This can only be accomplished by more economical methods, or by increased budgets, and often both are needed. Thus the haul becomes involved with the dump and the disposal plant, for oftentimes the method of disposal will increase or decrease the useful life of dumps.

4. Improved Operation of Dumps

The dump, in my judgment, is likely to be a factor in the disposal of refuse in nearly all cities for many years to come. It should, therefore, be given much attention in operation and use. Of first importance is the sanitary maintenance. Efforts to secure a rat-proof dump are becoming more prevalent, so that garbage is taken less frequently to dumps. The 1920 New York Commission reached the general conclusion that not only garbage, but rubbish and street sweepings as well, should be kept off of dumps. This consideration was an element in the decision which has led Philadelphia to take bids last month on a large rubbish and garbage incinerator.

As related to the problem of increasing hauls and the contingent stretching of the budget, the life of the dump becomes important.

This is a local problem involving the availability and extent of dumping areas and of other methods of disposal. Thus if mixed refuse (garbage, ashes and rubbish) is burned, the bulk to be dumped is reduced by 60 per cent or more. If the garbage is fed to hogs, only about one-third need be otherwise disposed of. The matter of available dumping grounds has become acute in many of the larger cities, including London and Chicago as commented on below.

5. A Typical Condition

In a typical large American city the refuse problem required the ultimate disposal of the following materials:

Ashes
Rubbish
Garbage
Manure
Street refuse
Trade refuse

In the smaller cities, garbage and rubbish assume a larger relative importance. These refuse materials are disposed of in a number of ways of which the following are typical:

a. Most of the street refuse and ashes with much rubbish is taken to dumps. Measured by quantity, by far the larger portion of a typical city's refuse is dumped.

b. Manure (stable refuse) is mostly transferred to farms and truck gardens, but some of it frequently reaches the dumps.

c. There is nearly always some salvage, chiefly of rubbish. This is often done by scavenging dumps, but sometimes in specially built plants.

d. Hotel and restaurant garbage is generally fed to hogs, or rendered for grease and, tankage. Relatively inert trade refuse is dumped. Thus the accessibility of dumps (or loading stations) affects the cost of industrial output.

e. A variety of special methods of disposal have been developed for garbage, sometimes with the admixture of rubbish, ashes and other refuse materials.

Thus, for a typical condition, we find disposal by dumping used for as much of the refuse as can be dumped without creating objectionable conditions; with special disposal works developed for the rest. There appears also to be in some cities a tendency to increase the proportion of refuse dumped either on land or at sea, sometimes resulting in the abandonment of the specially developed works.

The location and accessibility of dumping grounds is, however, a direct factor in the cost of collection and haul; and dumps gradually become permanently exhausted from refuse disposal. Cities should, therefore, give careful consideration to their dump resources, with particular reference to the collection service and to other matters of disposal which decrease the amount of refuse to be dumped.

6. A Yard-Stick for Haul

The matter of haul may, therefore, have a determining influence on the development of special methods of disposal and the conservation of dumps and it is therefore necessary to set up a measure for the relative value of haul. Local conditions will largely make up such a yard-stick, but the effect on collection service and cost is one of the chief factors. Some data on the rate of collection work are given in Table 1. As an average figure for a typical large city, let us assume that a collection unit of two men can make collections of house refuse at the rate of 75 pick-ups per hour. If the unloading point is so located as to require four hours of haul, each such collection unit will serve around 300 houses per working day. If the team haul be reduced to three hours, the number of pick-ups (or houses served) will be increased to 375 per day. Under some local conditions the team haul requires as much as five hours time.

TABLE 1

Rate of Collection Service Data from Office Notes and Field Investigations Pearse, Greeley and Hansen, September, 1922

CITY	MATERIAL	NUMBER OF HOUSES PER WAGON PER DAY
Pittsburg	Rubbish	145
Rochester	Rubbish	167
Charleston	Garbage	250
Fargo	Garbage	210
Toledo	Garbage	275
Montclair	Garbage	300
	Ashes	200

In larger cities, the team haul can be supplemented by quantity haul. If the team haul (averaged with collection service) costs $4.50 per ton, quantity haul may cost only a third as much or about $1.50 per ton. What then is the economical relation between team haul and quantity haul? Obviously this can only be determined after a careful study of all the local conditions, including the rate of collection work, the travel of teams and motors, the available locations for transfer stations, the life and location of dumps and disposal plants, rates of wages and other similar considerations. But the yard-stick for haul is the number of houses to which collection service can be given by a unit of collection and haul equipment. With due regard to the life of disposal works and to sanitary conditions, the work of collection and haul should be planned to serve the maximum number of houses per day.

7. *London Reports*

During the last 5 or 6 years, the refuse disposal of the Administrative County of London has called for special study, largely thru increasing costs of haul. From a population of almost four and one-half million, it is estimated that about 5,000 tons of refuse per day require disposal. The County is divided into 28 metropolitan boros and the City of London, making 29 divisions in all. The following figures show the proportions in which the various methods of disposal are used:

METHOD OF DISPOSAL	NUMBER OF BOROS	PERCENTAGE OF REFUSE BY WEIGHT
Barges to dump	22	44.66
River to dump	13	16.66
Incineration	14	18.66
Other methods	17	20.00

These data are taken from the very complete final report (1921) of the conference of Metropolitan Boro Councils, of which Mr. J. T. Watson was Chairman. Other methods of disposal include local dump, sorting for sale, etc. From these figures it appears that practically 80 per cent of London's house refuse is at present disposed of by dumping. A few quotations from the conclusion of the conference are of interest to municipal officials in this County as follows:

(a) *Dumping on the Land.* The system of dumping crude refuse on low-lying land, in disused clay-pits and in quarries, altho at present the principal means of refuse disposal, will, we believe, be generally condemned for public-health reasons if for no other.

From the point of view of public health no word can be said in favor of dumping crude refuse. Nearly all rural authorities strongly object to land in their areas being used for this purpose (altho they may adopt the same means of disposal), chiefly owing to the fact that at most dumps there is no organized method of covering over the top surface with suitable material, and no attempts are made to bring the land back into cultivation. Consequently there is a continual risk of nuisance being created by fermentation and the dump becomes a breeding ground for flies and rats.

(b) *Dumping in the Sea.* This proposition has been put to us, and while, if it could be assured that there would be no return of the material with the tides, the system would have the merit of being sanitary, the cost of the necessary transport to river-side wharves and sea hoppers removes it, we think, from the sphere of practicability. There is also the possibility of long delays owing to unfavorable weather conditions.

(c) *Burning in Destructors.* Refuse destructors have been in existence many years, and they have the undoubted advantage of disposing of the dangerous elements which develop in refuse when left to ferment and decompose.

As regards the utilization of the waste heat, this is of value for the driving of machinery for small subsidiary undertakings, such as a mortar mill, slab making, or a small electric light plant, but it appears that the variability in degree of heat produced by a destructor and the comparatively small portion of the 24 hours that it works, renders the application of the heat generated much less desirable for purposes of a power station than heat raised by ordinary fuel.

It is our opinion that the part to be played by the destructor in the future will be, not the burning of all refuse, but that part of which no further use can be made.

(d) *Pulverising or Crushing.* The boro of Bermondsey installed four refuse crushers in the year 1919 on the river front. The plant deals with 320 tons per week, or 16,640 tons per year. The present cost of crushing at Bermondsey is 6s per ton, owing to the high rates of wages now paid. The staff consists of 12 men and 1 foreman. Their wages represent 51.88 per cent, of the total cost of crushing. The boro engineer informs us that there has not been an extensive sale of the material and the Council have paid a small charge to the contractor for removing it.

(e) *Salvage of Usable Constituents of Refuse.* The suggestion was made at one of the meetings of the Conference that Mr. J. C. Dawes, Inspector of Public Cleansing of the Ministry of Health, should be invited to give us his assistance in our task. This was done. Mr. Dawes has attended most of our meetings, and we are indebted to him for much valuable information concerning the activities of provincial-local authorities in the matter of refuse disposal, and with regard to the great possibilities connected with the salvage of refuse and the installations that have been set up in various parts of the country for the treatment of refuse for subsequent use. But altho unsorted refuse is objectionable and would soon become dangerous to health, the fact remains that practically every one of its component parts separated from the remainder is a usable and useful commodity.

Salvage plants are still in their infancy, and we do not give any details as to capital costs owing to the variations possible according to the extent to which it is desired to sort the refuse and the manner in which the residue after sorting is disposed of.

The cost of erecting on a provided site a plant capable of dealing with from 20,000 to 40,000 tons of refuse per annum may be estimated at about £15,000. Allowing for repayment of capital and interest and for running expenses and taking only a moderate estimated return on sales, a very considerable saving can be shown over present-day costs of barging or railing to dump.

It is not suggested that destructors and other systems of refuse disposal showing some return on working should be scrapped, but it is suggested that in some cases (and they are the majority in London) where refuse is barged or railed to dump in its crude state, the Councils concerned would be well advised to give the closest and most serious consideration to the possibilities of salvage.

Mr. C. Newton Russell, chief electrical engineer to the London boro of Shoreditch has likewise submitted thorogoing reports on this subject. He states that,

The main defects in the present system are: expense, inconvenience and annoyance, necessitated in destroying refuse in the center of densely populated areas, owing to:

(1) Flue dust troubles.

(2) Congestion of traffic.

(3) Increased cost of disposal of residue, which has risen from 2/- per ton in 1897 to 5/- per ton in 1917, and is still increasing.

(4) Want of space to deal efficiently with by-products, such as: Flue dust, old tins and metal, bones, paper, straw, etc., and the utilization of burnt residue for the manufacture of paving slabs, mortar, bricks and road material.

He then outlines a constructive program in a suggestive way as follows:

In order to destroy and to efficiently deal with domestic and trade refuse, special types of furnaces are required, which it is impossible to have in small local plants. The remedy for this is, in the author's opinion, centralization, and in order that these notes may not only be of a negative character, and only critical, but rather of a constructive nature, with a view to increased economy and efficiency, as well as provision for the future, the following suggestions are put forward:

1. Collection of refuse—Depots for tram and water transfer.
2. Centralized destructor plant.
3. Conveyance of refuse, and return of by-products.
4. Selection of site or sites.
5. Layout of plant, sidings, workshops, offices, workmen's dwellings, etc.
6. By-product department.
    - Research department (chemists)
    - Generation of steam.
    - Disposal of residue.
    - Manufacture of concrete or lime and clinker blocks.
    - Clinker for road-making.
7. Financial aspects.

After suggesting a further development of sorting he offers a tentative scheme that:

> London should be divided into, say, four districts, with a central destructor plant on the outskirts of each area, and preferably with river frontage. As an illustration, take the eastern area from Shoreditch eastwards. A site could be obtained on the river front at Barking, or lower down. It should be connected to the local tram and rail system so that the refuse trucks could be run right into the works. The area of the site should be ample enough to provide for:
>
> Plant to deal with 2,000 tons per day.
> Electric generating plant.
> Repair workshops.
> By-product works for making:
>   Crushed and ground clinker.
>   Mortar.
>   Concrete slabs, etc.
>   Workmen's dwellings.

8. *Some American Conditions*

It should not be considered that English and American problems are similar. There are differences in the per capita production of refuse, in personal habits, in population densities and the like. Moreover refuse disposal in America is in process of development. Minneapolis, under the guidance of Mr. Engberg, city engineer, and Mr. Jensen of the water department has recently built loading stations to shorten haul, has motorized its garbage collection and is considering an increase of incinerator capacity.

Mr. John Klorer, city engineer of New Orleans, has developed disposal by incineration only after a most careful study of haul economies. Chicago, with the lake front still available for dumping, is feeling the pinch of filled-up dumps and longer hauls. Indianapolis has developed a tractor-trailer system for ash collection to decrease the increasing costs of collection and haul. The conditions now in London and in some American cities, may come to other cities before many years. There is a limit, in most cases, in built up communities, to the nearby dump. Special methods of disposal and a comprehensive general plan for collection and haul are the necessary steps if service to householders is not to be curtailed. The wise communities are planning now the conservation of dumps.

9. What About Failures

As commonly considered the term "failure" as applied to refuse disposal projects, refers to the abandonment of a finished disposal plant representing invested capital and ready for operation. If a considerable sum of public money is put into works and these works are not used but are allowed to disintegrate, something is certainly wrong. Many will say that such occurrences are rare, if not unknown. Let me name a few cities where some such upsets have occurred for part or all of the refuse:—New York, Buffalo, Minneapolis, Chicago, San Francisco, Los Angeles, Seattle, Gary, Fargo, Madison and others.

Such upsets, however, are not the real failures. They are the symptoms of a deeper trouble. I offer for your consideration some of the causes of these upsets and plant abandonments as follows:

(a) A failure, in the first place, on the part of city officials, to appreciate the true measure of a refuse disposal project. Communities should understand that the first objective is a city of clean houses, with the construction of a disposal plant second.

(b) A failure to secure and adopt a general plan for all the refuse disposal work including proper ordinances and kitchen cards, collection equipment and management, transfer stations, hauling equipment, dumping facilities, disposal work and the like.

(c) Failure to profit by cooperation with experts of independent judgment who can bring to the local problem the helpful experiences of other situations acquired thru years of study and participation.

(d) A failure to operate the work with reasonable skill and economy. Hind sight is always better than fore sight, but we are accumulating much experience that is of value to developing a general plan for a city and this experience should be used.

10. Summary

A review of refuse disposal practice including some of the mistakes which have been made clearly indicates the need for a broader development in the solution of the problem. The final objective of a clean city should stand out and be accomplished thru a sound general plan based on experience with tried methods, economically operated. The complexity of the problem is obvious.

By way of illustration my partner, Mr. Paul Hansen, has devised a chart (not reproduced) showing the fundamental considerations in the refuse disposal problem and their many relationships. There are four principal elements to deal with and three to be satisfied, including householders, the public, the operation and its economy. Between these four factors, namely house treatment, collection, haul and final disposal and the three elements to be satisfied, there appear to be nineteen different relationships. Thus, collection is not only influenced by the house treatment and haul but also by items of cost in operation, public considerations, methods of final disposal and the like.

Out of these various relationships there is some combination of house treatment, collections, collection equipment, transfer stations, haul, disposal plants, dumps, sites and locations, business management and accounting which will produce the most favorable solution. Like all major engineering problems, but in a marked degree, the refuse disposal problem is one which cannot be reduced to mathematical calculation, but must be solved on a basis of experience by those who have had opportunity to study and correlate this experience in a broad manner.

MODERN REFUSE DISPOSAL BY INCINERATION

By Robert W. Haff, Inland Engineering Company, New York City

The municipal refuse of the cities of the United States is cared for in many ways, but those that are disposing of their refuse in a modern, approved, sanitary manner are using either the process of incinerating the refuse, or reducing and rendering the garbage and burning the combustible rubbish.

The main thing to be remembered about installing any method of disposal is that the primary object is to remove this objectionable material in a complete manner from the community. This removal should be done in the most sanitary way possible, as quickly as possible, and at the lowest possible operating expense. Then, after all these conditions have been fully satisfied, if there can be any revenue thru the sale of by-products obtained, or otherwise, it is time to consider this phase. The ordinary layman is liable to think first of revenue and not of the fact that what is really wanted most of all is the complete removal of the refuse in a sanitary way.

Incineration is the most popular method of disposal in the United States today.

The incinerators can be of economical size, located at various points in the city, and the loaded wagons come direct to each plant. The incinerator therefore consumes all classes of material at the one plant, without nuisance, (if the plant is properly designed), and reduces the collecting and transportation expense.

The cost of refuse disposal should be considered as a whole and not after the material has reached the point of final disposition. The cost should cover the disposal of the refuse from the time the receptacle is emptied into the collecting wagon at the point of origin, until it has been finally disposed of in a sanitary manner. The cost of collection runs from five to six times that of final disposal in the best of plants and the incinerator reduces this cost to a minimum. When the cost of disposal is considered as above outlined, the incineration method is by far the most economical.

Some laymen think the salvaging of the rubbish for salable paper, rags, etc., should be done, but it can be shown that this material had better be used as fuel to consume the garbage.

Incinerators

In the United States there are installations of incinerators of all classes and types. A large number of the plants that have been installed in this country were of the cheap, unreliable and slow-burning brick type, such as installed from about 1890 to 1905, but many of these have since been replaced by the modern fast-burning type of plant.

The refuse produced in the cities of the United States, and no doubt in the other cities of North and South America, contains a much higher percentage of moisture than that of the European countries. The people of this less congested hemisphere waste more of their food-stuffs in the form of garbage than those across the Atlantic.

The ashes produced in the United States do not contain the percentage of unburned coal that those of Europe do, as the heating plants of America consume the coal much more completely.

These two conditions, as well as the higher cost of labor, have prevented the European type of incinerator from producing economical results when operating in the United States and Canada.

The various incinerators as installed in the United States and Canada today, can be classified into three groups: low, medium and high temperature types.

Low-Temperature Type

There are many makes of plants that come under the classification of the low-temperature type. The main argument in favor of these is their comparatively low first cost of installation.

These plants are of fire-brick construction, having a series of superimposed brick arch grates to receive the refuse as charged in and hold it in the flames for drying purposes, or they may simply be of the dutch-oven type with a low-hanging, flat, brick arch which is supposed to divert the flames down onto the refuse.

These plants have large grate areas with usually short stacks that give insufficient draft and that have insufficient separate gas-combustion chambers to obtain complete combustion of the gases before they escape to the atmosphere. In many types of this class no separate gas-combustion chamber is provided.

They are not provided with any means of mechanical draft, either forced or induced, and consequently the rate of combustion is slow and the fires are sluggish. The result is that a frying or stewing process is obtained and the escaping gases of combustion from the stacks are not odorless and become a nuisance to the surrounding neighborhood.

This type of plant can handle material which is largely combustible, such as rubbish and paper, but when any quantity of garbage is in the refuse they require considerable fuel to consume it. Some of them require as much as 300 pounds of coal to the ton of refuse consumed.

The absence of the heated forced draft, as well as the resultant slow rate of burning, means a temperature in the furnace too low to give the best combustion. For odorless operation a plant must have a separate gas-consuming chamber in which the gases of combustion can be held at a sufficient temperature while they are completely burned before they escape to the atmosphere thru the stack.

In this type of plant the refuse is usually charged in large quantities directly onto the fire, or in the path of the flames, tending to smother the fire and retard the combustion. Because of this, and the fact that in many of them they attempt to burn from the top down, a large amount of stoking and agitation of the burning refuse is necessary and the resulting ashes are not thoroly burned, containing considerable organic matter.

In short, in this class of plant the destruction is neither thoro, odorless nor strictly sanitary.

Being of fire-brick construction the maintenance cost is high as the brick work needs constant patching and repairing because of the excessive strains caused by the wet material coming in contact with the heated brickwork when fresh material is charged in and also because of the contraction and expansion strains due to intermittent daily operation. This necessity of repairs is not only added operating expense, but it requires the shutting down of the plant for periods, during which there is no means of disposal for the refuse.

The location of such a plant should be on the outskirts where the odors produced will not raise any objection.

The builders of this class of plant will give very limited guarantees covering definite operating results and there are many of them reluctant to give a bond covering the guarantees and operating results.

This type, or class, of incinerator is not the most economical in the long run, even tho its first cost of installation may be even as low as one-third the first cost of a plant of a better class. It will cost more to operate per ton of refuse consumed, cost more to keep in repair and it will not do its work as thoroly.

In the United States this type of plant is largely used in the smaller cities where they cannot afford the more expensive installations and where a location in the outskirts is available without making a long haul.

High Temperature Type

When this type of plant is referred to, one naturally thinks first of the high-temperature plants of European design which are very costly to instal and operate and complicated in their structure. As above stated these plants were designed to meet European conditions where the refuse contains a higher percentage of dry combustible and the ashes have a larger amount of unburned carbon in them, than in America.

These high-temperature plants are of fire-brick construction of the multiple-cell type. By this is meant that there are several small furnaces or cells each with a small grate surface that are all operated in connection with one gas-consuming chamber. The cells are charged alternately with small quantities (1 to 2 cu. yds.) of refuse which is thoroly consumed and the ashes and clinkers removed before another charge is introduced. The result being that one cell is always up to heat.

Some of these plants are provided with hydraulic clinkering and charging devices to try and reduce the large amount of hard labor necessary in the operation of these many small furnaces, or cells. These have not, however, proven thoroly satisfactory because of the varied class of material being handled, their complicated nature, and the very high rate of depreciation because of municipal abuse and the large amount of dust and dirt present in a plant handling this mixed refuse containing ashes.

The fact that in this type of plant the refuse can only be charged in small quantities means that the refuse as received at the plant in carts must be stored and these storage-bins are extremely unsanitary, and even tho the plant may not give off any odors from the stack, nevertheless, there will be odors arising from these bins.

This plant requires that ashes be mixed with the refuse in case the refuse contains any garbage to speak of, or else some commercial fuel must be used to furnish the necessary heat units to maintain the brickwork at a sufficient temperature to burn the refuse. While this may be a slight advantage at the household to put all classes of refuse in the same can, it simply means that in a given community, a larger plant will have to be built to do away with the objectionable wastes, than is necessary with another type.

The greater tonnage of refuse to be put thru the plant under the above conditions, (when ashes are mixed with the refuse), not only increases the installation cost of a plant for the city, but requires more labor to operate the plant and produces a higher percentage of ashes and clinker to handle and dispose of. The highest percent of unconsumed carbon in the ashes of the United States is about 25 percent, which means that under perfect conditions, 75 per cent of the ashes charged in with the other refuse must be stoked, handled and removed as resulting ashes and clinker and hauled away.

This type of plant uses preheated forced draft and the rate of combustion is rapid. They can be centrally located within the city as obnoxious gases are not produced from the chimney.

The temperatures maintained in the gas-consuming chambers of this type of plant are excessively high. Odorless combustion is not alone a matter of temperature, and all temperatures above a certain point are maintained at a greater operating and maintenance expense for they cause a higher rate of depreciation of the materials of construction with no additional benefit.

Plants of this type are only adapted to 24-hour operation. They have a high cost of installation, are complicated to operate, require skilled superintendence as a rule and a larger amount of labor.

The high-temperature type of plant has not shown itself to be suited to handle general run of American refuse to the best advantage.

Medium Temperature Type

This type of plant has been developed in America and it is best suited to handle the refuse of this hemisphere.

These plants are equipped with forced draft insuring rapid combustion and they have separate gas-consuming chambers where the temperatures are kept at a high enough point to insure a complete chemical action in these gases of combustion before they reach the chimney. These plants are odorless in their operation and they can be centrally located.

Some of the plants of this type require fuel to consume refuse containing garbage in large quantities, but they use much less fuel than the low-temperature type of plant. In some of these plants a small percentage of ashes is necessary in the refuse in order to operate without fuel.

This type of plant sometimes is equipped with preheated forced draft while in other makes air at the temperature of the operating room or the outside is forced beneath the grates.

These plants can be operated any length of period desired and most of them are operated daily, except Sunday, over 8 to 12 hour periods.

Some of the plants of this type require the use of storage bins for holding the refuse as received from the carts. The refuse is charged into the cells or furnaces from these bins in small quantities similar to the method used in some of the high-temperature plants. These bins, of course, are extremely unsanitary and a breeding place for flies. Odors are bound to be given off by this refuse waiting for consumption.

All the plants of this class are of fire-brick construction except one type, known as the steel water-jacketed type. The fire-brick plants of this class use either the drying-hearth principle where the refuse is charged onto a hearth or shelf adjacent to the burning refuse on the grates, and the flames pass over the fresh material, drying it before it is pulled over onto the fire, or else a system of superimposed brick arches or upper grates. The combustion in these brick plants is either downward or across, so that the freshly charged refuse has a smothering effect on the fire and they require more stoking of the refuse and consequently more labor than the steel water-jacketed type.

When properly operated this medium temperature type of plant produces well burned ashes free from organic matter and freedom from creating a nuisance by reason of escaping odors from the chimney.

The fire-brick-lined plants of this class, like those of the high and low-temperature types, are subject to the high maintenance expense because of the frequent repairs necessary to their brick lining because of the high rate of deterioration due to the wet material coming in contact with the hot brickwork, as well as the expansion and contraction strains. Hand in hand with this comes the period of idleness of from one to six weeks each year to make these repairs to the brickwork after the plant has been operating possibly two to three years.

The steel-water-jacketed type of plant is extremely sanitary in one particular, especially, and that is, that they require no storage of refuse about the building in any manner. The loaded wagon drives in on the upper floor of the building and dumps its load thru a hole in the floor into the furnace below. Bodies of horses, cows, etc., to be burned are also charged thru these same holes in the floor without any need of mutilation. The furnace below is constructed so as to receive the refuse into its basket-grate as fast as it reaches the plant under normal conditions. The result is that all refuse is stored in the furnace and surrounded by the flames of the burning refuse on the lower grates.

The floors of these plants are of concrete sloped to drains and hot water and steam are always available, without cost, to wash the floors and wagons.

This has no fire brick lining in the charging chamber or furnace proper, which the wet refuse charged in can come in contact with. There is no such brick lining to require repairing and replacing. The walls of the furnace are made of two heavy steel plates stayed together and with water between making an indestructible water-jacket to take the place of the brickwork used in other plants. This durable construction makes the maintenance expense in this type of plant a minimum.

The most distinctive feature of this plant, however, is the suspended water-cooled basket-grate that is constructed of heavy pipes inside this chamber or furnace. The refuse charged into the furnace from the floor above is caught and stored in this indestructible basket-grate where it is held above the burning refuse on a lower cast-iron shaking grate below in the path of the flames as they leave the furnace at one end.

The freshly charged refuse does not hinder the combustion on the lower grate even if the basket-grate is filled with refuse to the floor level above, as the vertical water-cooled pipes at the sides and end of the basket keep the refuse away from the walls of the furnace sufficiently to allow free passage of the flames and gases of combustion into the gas-combustion chamber adjaacent to the furnace.

The ash-pit beneath the lower grate into which the fine ashes fall is of air-tight construction and the heated air from the forced draft fan enters this pit thru underground ducts and control nozzles. The principle of this forced draft is identical with that employed in the blacksmith's forge and the passage of this heated air up thru the fire causes rapid combustion and an intense heat, which consumes the refuse and fuses the incombustible materials into clinkers, which are from time to time removed thru doors of the furnace provided for that purpose.

From the furnace the gases of combustion pass into a fire-brick-lined gas-combustion chamber where they expand and consequently travel at a reduced velocity. The walls of this chamber are of steel plates lined with fire brick that absorb heat and maintain sufficient temperatures in this chamber so that the chemical action in these gases is completed before they leave the chamber, and consequently removes the chance of odors escaping from the chimney which might cause a nuisance to the neighborhood. Fire brick under these conditions are long lived as no wet material can come in contact with them.

The temperatures in this chamber are maintained at a high enough point for the burning of these gases and not an excessively high point, such as in the high-temperature plants, which causes more depreciation in the materials of the plant without any additional benefit being received.

A stream of fresh air from the fan is also introduced into this chamber in order that sufficient oxygen for the chemical action will always be available. There are also provided in this chamber checker-walls for catching large particles of unburned paper, etc., that may be drawn over by the strong draft, and the necessary pits and baffle-walls for collecting particles of dust carried over.

After leaving this gas-combustion chamber, the gases pass thru the preheater, or regenerator. The function of this preheater is to catch a portion of the waste heat that would go to waste up the chimney and return it to the fire beneath the grates in the form of a heated forced draft, the idea being that the hotter the fire, the hotter the forced draft supply and so on up until the proper heat is obtained to do the work.

The preheater consists of a large number of tubes arranged in staggered rows thru which the gases of combustion pass on their way to the chimney. The air for the forced draft is passed thru the preheater around the outside of these tubes and it picks up the radiated heat from the hot gases inside the tubes. By this means, the air supplied to the ash-pit ranges in temperature from 300° Fahr. to 500° Fahr. before it ever reaches the fire.

The steel water-jacketed plants including the buildings and chimneys, as well as the equipment, are built substantially and while their initial cost of installation is higher than many other types their sanitary construction, low cost of maintenance and operation, and their unexcelled durability make them economical in the long run.

Practically all the steel water-jacketed plants handling mixed refuse are operating without the use of any fuel and the makers guarantee that not over 50 pounds of coal per ton of refuse consumed will ever be required with their plant.

REPORT OF COMMITTEE ON WATER WORKS AND WATER SUPPLY

George W. Fuller, Chairman, New York City

This committee report records a number of points of interest in this important field of municipal improvements to facilitate discussions at the convention.

1. As this report is sent to the Secretary it is worthy of record that much anxiety is felt by the water works officials to whom falls the responsibility for the supply of coal needed at pumping stations. This is because there has been a coal strike since early spring and also a strike on the railroads since July 1 of certain important operating groups, including shopmen and maintenance-of-way men. The rationing of a limited supply of coal by Federal and State boards is of course helpful, but it does not eliminate the anxiety of manymembers of this association.

2. The past year has been a notable one of the reconstruction period following the Great War as regards the lower cost of money, particularly the rates on bond issues for municipal improvements, and the substantial stabilization of labor and materials, comparatively speaking. Construction materials are now 60 to 70 per cent above pre-war normal. The labor market varies widely in different sections of the country, both as to quantity and price. In some localities labor is available at almost pre-war prices while in other localities it is scarce and at nearly double pre-war normal.

3. Many water-works improvements have moved forward actively during recent months and there is little or no indication that sizable projects are being held up in anticipation of substantially lower prices than now prevailing. On the contrary, there are many who feel that construction costs are likely to increase rather than decrease.

4. Numerous water supply improvements, deferred in many instances as a result of the war, are now under construction. Filters and reservoirs are being extended at many large cities. The cities on the Great Lakes as a group have been particularly active in the installation of filtration plants. Cleveland is building a plant for its easterly works; Detroit has been pushing forward

filter construction for the past two seasons; and Buffalo has awarded a contract for practically all the excavation and concrete which will be required for the filter plant authorized at the election last November. Milwaukee has increased its rates whereby it will secure funds for filter construction which is not yet under way actively. Important projects for water supply improvements are moving forward at Wheeling, Omaha, Memphis, and other sizable cities; and an eleven million dollar bond issue for new supply works was voted at Kansas City last April.

5. The municipal water softening plants at Columbus, Ohio, and Grand Rapids, Mich., are being increased to practically double the capacity of the first installation and the benefits of a softened water are being considered quite seriously at Kansas City, Minneapolis, and other communities. New softening works are being built for Newark, Ohio, and Benton Harbor, Mich.

6. Some of the larger communities of the country have given much consideration to mapping out a future program as to additional sources of municipal water supply. Such a report was made to the Massachusetts Legislature as to supplementary works for the Metropolitan Water Supply of Massachusetts. Such investigations are also under way for works to supplement the Catskill supply of New York City and a report on future water sources for Philadelphia was made in 1920. Similar investigations are pending at Denver and some other large American cities.

7. So far as known to the committee, there have been no novel or unusual features developed in water works practice within the past year. Technical men have considered and discussed the present status of hydrogen-ion concentration in the control of water-purification plants. So far as now apparent, it is not likely that plant designs will be substantially changed as a result of this new method of studying the most suitable condition in which a water may be prepared for passage thru rapid or mechanical filters. Engineers and plant managers await word from the laboratory men as to the practical significance of this new way of controlling filter operation. Extensive reports covering recent scientific investigations in water purification will be found in the current proceedings of the American Water Works Association and the American Chemical Society.

8. Official government standards for the quality of drinking water, so far as water used by the railroads and steamboats is

concerned, have been measured since 1914 by the so-called Treasury Department Standard, formulated by a commission appointed by the United States Public Health Service. Last May a commission was appointed to consider what, if any, modifications of these official standards are needed both as to laboratory methods and interpretation of the same.

9. Industrial wastes have proved bothersome to water supplies in various sections of the country, both in type and intensity of the problem. This subject is intimately related to the legal status of the question, not only as regards the statutory control by states of such types of pollution but also as relates to the interpretation by the courts of the equities of the respective parties under the common law. The question of stream pollution in the coal-mine regions has long been under active discussion. An exceedingly important case in equity has recently been heard at Uniontown, Pa., where an injunction was sought by the Mountain Water Supply Company, a subsidiary of the Pennsylvania Railroad, to enjoin the discharge of coal-mine drainage into the streams tributary to the Indian Creek reservoir supply by the various coal companies operating in the valley above. The outcome of this case will be looked forward to eagerly by many who have to consider the pollution of streams by such wastes.

THE CLEVELAND WATER SUPPLY

By A. V. Ruggles, Commissioner of Water, Cleveland, Ohio

(Following is the stenographic report of Mr. Ruggles' address, revised to eliminate references to the numerous stereopticon illustrations, showing maps and plans, none of which were furnished for publication herewith.)

I have been asked to give a brief talk of ten or fifteen minutes on the Cleveland water supply, and on the improvements upon which we are launched.

We get our water supply from the lake, four miles from shore thru two tunnels. The west-side crib is submerged, with 32 feet of water over the crib. The water comes in thru a tunnel 10 feet in diameter and then thru two smaller tunnels to the station at West 45th street.

Our other intake crib is close by, less than a mile from the first, and has a steel super-structure so that you can see it from the shore. That crib admits water at about 20 feet below the surface, then it drops down and into an inside shaft to a level of 100 feet below lake surface, or about 50 feet below lake bottom and comes in from there in a 9-foot diameter tunnel to East 49th street.

We have divided our water supply system into four service districts. The low service area is from lake level up to 120 feet above lake, comprising about half of the total area which we serve and about 80 percent of the water pumped. We pump to this low-surface area from both of the lake-front stations, West 45th and East 49th, and have a reservoir taking up the inequalities of the flow at Fairmount, about 4 miles from the lake shore.

Out first high service area is from 120 feet above lake to 250 feet above lake, and is a narrow area in the east part of the city, just south of Euclid avenue, and reaches up to the brow of the hill. On the west side it is a large area, which is rapidly developing.

We get water up in the first high area by pumping some from the west-side station directly, and by boosting other water from the Fairmount reservoir with pumps at that location, with a reservoir at Kinsman taking up the inequalities in pumping.

Second high service is the region from 250 feet above lake to 500 feet above lake. The water is pumped up into that region from Fairmount Reservoir by other pumps at that point, with an equalizing reservoir out near the Warrensville city farm. At this point we have some small pumps and a tank, so that from there we pump a little water up to a little over 800 feet above lake.

The river cuts our city in two, and in the low service region we have five tunnels with mains thru them carrying the water under the river. Four of those tunnels are in use; in the other we never have as yet laid a main. In the first high, we have one line submerged under the river, but it is not in a tunnel.

On the west-side, developments for water supply, and also for sewerage, are being carried on by the county, under a separate sanitary district organization permitting unincorporated areas to go ahead and get their own water supply system installed and then buy the water from the city of Cleveland. They have already built a small pumping station, perhaps 6 miles from the lake and are pumping some water to second high, and are about ready to pump a little to third. The limits between the districts are the same as over on the east side, as to elevation.

We have on the west side a filtration plant where we filter all the water coming thru the west-side tunnel. It is a rapid sand-filter plant of modern type. The water coming thru the east-side tunnel is not filtered, but is treated with chlorine, and we have under way a new filtration plant on the east side. When that is finished, in about three years, we will then furnish filtered water to the entire city.

At the west-side pumping station we have pump capacity to pump 90,000,000 gallons a day into the low service and 50,000,000 gallons a day into the first high. On the east side we have 130,000,000 gallons a day capacity in the low service and at Fairmount we have a smaller pump installation pumping into the first high from 10- to 22,000,000 gallons a day and in the second high from 9- to 14,000,000 gallons. We have a 5,000,000 gallon pump at Kinsman which also pumps into the second high.

We have our general water-works yard out on the east side of the town at Woodlawn avenue and 79th street, where we maintain our pipe yards and storeroom, facilities for testing and repair of meters, and other work of that kind, being centrally located for all the needs of the department.

In the way of present statistics for the department, we are now serving water to a total area of 126 square miles, of which over half is outside the city proper. By 1940 we expect to be serving water to the whole county and some more, about 475 square miles. In fact, we are sending some outside of the county at present.

Our population served with water in 1920 was 907,000 people. In 1940 it will be 1,624,000 and in 1960, 2,500,000, according to our estimates. Our average density of population in the city proper is now 22 and will increase by 1960 to 36 people per acre.

Our per capita consumption of water from 1914 to 1919, averaged 124 gallons daily. In 1920 it ran 155 gallons, that being the year of good business. Last year it was down to 135, because 60 percent of our total consumption of water is industrial. In the future, for the total population supplied we figure that our per capita consumption will increase from 160, in 1925, to 175 in 1940.

In 1920 the average amount of water we pumped per day was 141,000,000 gallons a day, and the maximum for any day that year was 167,000,000 gallons. Generally, a maximum day for any year runs 41 percent higher than our average thru the year and that factor tends to decrease for us as the city becomes larger, and the same holds true in the separate service districts.

Yesterday we pumped from the lake 146,000,000 of which 120,000,000 gallons went into the low service, the first high service received 30,000,000, the second high service 12,000,000 and the third high service 300,000 gallons.

Our total pumpage we estimate in 1930 will be 273,000,000 gallons a day, in 1940, 363,000,000, and in 1960, 548,000,000 gallons a day. That will be divided up, at that time, between the service districts in such a way that in the low service we will be using twice what our total is now and in the first high service an amount larger than our present total.

The rates we charge for water here are 60 cents per 1000 cubic feet in all parts of the city regardless of elevation of service district, and with a semi-annual minimum of $3. The water we sell to the suburbs is sold at higher rates, partly by direct service where we read the individual meters and collect the bills from the individual customers, and in other places by master meters on the large mains where they cross the city or village corporate limits. In the low service by master meter we sell to the suburbs at 80 cents per 1000 cubic feet up to a total of 36,000,000 cubic feet in any one year. Above that, we sell it at a lower rate or 60 cents per 1000 cubic feet. In the first high service where we sell by direct service we charge $1.10 per 1000 and a semi-annual minimum of $5. By master meter in that same service district it is $1.00 below and $0.80 above 36,000,000 cubic feet per annum. In the second high service on direct service it is $1.50, with a semi-annual minimum of $6 with rates by master meter of $1.35 and $1.15, below and above 36,000,000 cubic feet per annum, respectively.

What I should speak of to this organization is what we are planning for the future. We have forecast our growth of population up to 1960, in all parts of this county, and are preparing to meet the needs for water supply as best we can, and have laid out the part of the improvements which we shall have to carry thru in the next five years as part of a 20-year program..

We have now under construction a new filtration plant, reservoir and pumping station at Fairmount, which will operate in a different way from the present system, giving us better pressures in the low service and much larger pump capacities to send water up into the first and second high service regions.

Some of you may have seen under construction thru the park the lines carrying the unfiltered water from the lake at East 49th street up to the Fairmount reservoir. There are two 60-inch lock-bar steel pipes. The pumping station for boosting that water up to the filter plants is now being built. The excavation is under way and the station will contain, when finished, three pumps with a total capacity of 200,000,000 gallons daily for lifting the water from this reservoir to the filters, also two pumps with a total capacity of 40,000,000 gallons a day, to pump to first high, and three other pumps of 60,000,000 gallons capacity to pump to second high. Those pumps will all be centrifugal pumps, steam turbine driven, and the boiler house will contain four 1000 h.p. boilers, steam running a little over 300 pounds pressure.

The filtration plant will be of the rapid sand type. One new feature will be utilizing the principle of the hydraulic jump for mixing the alum solution with the raw water.

The Baldwin reservoir, which is under construction, serves both as a clear-water basin for the filter plant and as a new low-service distributing reservoir, replacing the old Fairmount station in that function and giving us more storage and better pressures down in the low service. In the lounge room we have enlargement of photographs taken of that reservoir. The reservoir is forty feet from floor to roof and is rather beyond precedent in its dimensions both in height and in spacing of the columns.

The Baldwin-Fairmount project, as we call it, comprising the filter plant and pumping station buildings, entails fifteen new buildings. We are getting the best of talent which we can on the architectural and landscape features of this work so that these buildings will be uniform in type and pleasing in appearance. We are bending all efforts to carry thru a landscape program which has been recommended to us, with the hope that this plant will not only be a success from an engineering point of view but also will be a plant which the city will be proud of and which all visitors to the city will not fail to see when they are here.

DISCUSSION

Mr. Folwell: I would like to ask if there is any connection between your various services, between your low and first high and second high, whether they are interconnected in an way?

Mr. Ruggles: We usually have no physical connection, but in some cases those lines have been shifted, and in those cases we keep the valves closed, of course, between the two. There are quite a good many places where there are actual connections but with the valves closed.

Mr. Folwell: You do not calculate to use high service pressure in low service districts, do you?

Mr. Ruggles: Yes, we do that in some cases where the pressure is too low in the case of fires, etc.

REPORT OF THE COMMITTEE ON MUNICIPAL LEGISLATION AND FINANCE

James E. Barlow, Chairman, New London, Conn.

The field which might be embraced in the work of the Committee on Municipal Legislation and Finance is almost unlimited and any questionnaire of reasonable length if sent out would hardly bring forth adequate information. The report which is herewith submitted merely directs attention to some phases of the subject coming to the attention of the writer.

Finance

With the advent of the war and its aftermath, practically all cities have had to wrestle with serious financial problems. Some of the contributing factors which either decreased revenue or increased costs, may be mentioned as follows:

(1) Increased cost of labor and materials.

For example, the expenditure for grade schools in New London, Connecticut, has increased in the last five years from $120,500.00 to $263,100.00; in the same period the police payroll has increased from $25,600.00 to $86,800.00.

The cost of coal for municipal purposes in Dayton, Ohio, increased in two years from $23,000.00 to $81,000.00.

(2) Loss of liquor license revenue.

(3) Increased cost of utility and other services furnished to the city. (It is interesting to note that the Legislature in Connecticut has provided financial relief for the street railways at the expense of the cities. The street railways formerly paid for and maintained the paving within car tracks and 24 inches outside; now state legislature has relieved them of this obligation except for an 8 inch strip on each side of each rail.)

(4) The crime wave and epidemic of strikes have increased the burdens on police departments.

(5) There has been a demand for increased service in health and social welfare work, in recreation, parks, for better building codes and stricter enforcement thereof, etc.

(6) Tendency to shorten the hours in the police, fire, and other departments.

For example, in Dayton the firemen, in pre-war days, had one day off in five: this was changed to one day off in two, or 24 hours on and then 24 hours off duty; this greatly increases the number of men required to man the apparatus: in the same period the pay was increased from $80 to $135 per month. In Cleveland, the public even voted an 8-hour day, meaning three complete shifts for the firemen as compared with two in Dayton.

(7) Great increase in motor traffic, both in pleasure vehicles and trucks, resulting in

(a) Necessity for building more expensive road surfaces and bridges.

(b) Increased maintenance cost of streets.

(c) Increase in cost of handling traffic, necessitating more traffic officers, the maintenance of more traffic signals and the marking of safety and parking zones, the following up of auto thieves, stolen machines, etc.

Some of the steps taken to meet these increased financial burdens may be mentioned as follows:

(1) Increase in tax rate and increase in the valuation of property.

An example of this is given in the following table which is for New London, Connecticut (population 1910, 18,000 and 1920, 25,000).

YEAR	TAX RATE	GRAND TAX LIST	AMOUNT LEVIED
	mills		
1915–16	18	$22,191,905	$399,454
1916–17	18	25,140,103	452,521
1917–18	18¾	28,649,032	537,169
1918–19	22	29,370,694	646,155
1919–20	26⅞	32,088,511	862,378
1920–21	33¾	33,273,899	1,122,994

From the last column in the above table it will be seen that the amount of money due upon the tax levy of 1920–21 was nearly three times that of 1915.

In some states, as in Ohio, the state raises revenue by a millage levied uniformly upon all the taxable property throughout the state. This works to the advantage of those communities which keep a low valuation on property with a correspondingly high tax rate. Those cities on the other hand, such as Cleveland, which more nearly comply with the law requiring full valuation, bear an undue share of state taxation. Thus, if two cities in Ohio raise the same amount of money thru the general property tax, but the first does it with half the valuation and hence double the tax rate, the second would have to contribute just twice as much towards the support of the state. This condition, which applies to country levies as well as state, has been no small factor in defeating the successful operation of the Smith one-percent tax-limit law in Ohio. In Connecticut, on the other hand, the state collects its revenue from the local taxing units in proportion to the average amount of money collected by each taxing unit during the three preceding years without regard to tax rates or valuation of property.

(2) Increase in the rates of public utility service owned and operated by the city. In Dayton the water rates were increased 50 percent during the war period.

(3) Increase in various licenses and permit fees collected by the city for building permits, for special privileges, etc.

(4) Inauguration of new taxes such as inheritance tax, income tax, special business or occupational tax.

Thus, Cincinnati inaugurated an occupational tax in 1919, from which is derived an annual revenue of $500,000.00.

(5) Increase in registration fees for motor vehicles and returning part of same to the political sub-division where the vehicle is owned.

Ohio increased the auto registration fee and returned part of the revenue derived to the political subdivision where the vehicle was owned. Dayton, Ohio, derives a revenue of about $110,000. per year from this source.

(6) Tax on gasoline and sign boards.

For example, State of Connecticut now imposes a tax of 1¢ per gallon on gasoline. This indirectly relieves cities, as otherwise the State might have to raise more money from local tax on property.

(7) Local license fees for motor vehicles.

(8) Special assessments on property benefited to pay for improvements instead of paying for same from general taxes.

The practice varies widely in different parts of the country. In Ohio the property owner pays 98 per cent of the cost of the street pavement in front of his property, while in Connecticut the general practice is for the entire cost to be paid from general taxes.

(9) Inauguration of more economical administrative methods centralizing responsibility, the installation of better accounting systems giving intelligent financial control, the adoption of detailed budgets, the appointment of municipal purchasing agents with requisition system, stores accounts, etc.

Legislation

The progress in municipal legislation in any one year is hardly discernible, so it is necessary to look back over a period of years to discover the tendencies and advancement made.

"Home Rule" for cities, which has been agitated for many years, has, in some instances, been granted in a very large measure by state legislation, as for example, in Ohio. In drafting new municipal characters there has been a marked tendency to lessen the number of officials to be voted for. There has likewise been a noticeable endeavor to centralize administrative responsibility.

Initiative, referendum, and recall provisions which only a short time ago were considered radical theories are now embodied in many charters and readily accepted. Proportional representation has been included in several charters, noticeably in the new Cleveland charter which takes effect one year from next January. Direct primaries and non-partisan ballots are now the general thing in new municipal charters.

Many cities have adopted zoning laws, tenement house laws and building laws which a few short years ago would have been considered a transgression on private property rights.

City-planning boards have been created with broad general powers and more attention is being given to the orderly development of the city. The scope of the city-planning movement has been enlarged and we now have regional plans being developed.

Several cities, including San Francisco, Seattle and Detroit, have extended their municipal ownership activities to include street railways, the ultimate outcome of which will be watched with interest.

There is a growing appreciation of the fact that to conform to a sound financial policy, bonds should not run for a longer period of time than the life of the improvement which their proceeds purchase and that the bonds should be either serial or sinking fund issues, thus being gradually retired during the life of the improvement. In Ohio this policy has been put into statute form. Under such a plan of financing, the municipality is in effect paying for the improvement as rent, much the same as does the individual who buys and pays for a home thru the building and loan association.

In Ohio, and possibly other states, legislation has been enacted which allows the creation of districts, comprising several or parts of several political subdivisions, for the purpose of paying by special assessment for projects which benefit the district and which could not be carried out by any one of the political subdivisions alone. Thus, a sanitary district for the construction of a sewerage system or a sewage-disposal plant can be created to serve several communities. Or, a district can be created to provide protection against floods as in the Miami Conservancy District which comprises parts of nine counties, centering at Dayton, Ohio. This latter project will cost approximately $35,000,000.00, paid for by special assessment upon the property within the district.

James Bryce has forcefully called attention to the fact that the government of our American municipalities was the weakest link in our democracy. However, changes have been taking place gradually. The old town meeting of New England was very democratic but as the town grew, it became unwieldly. Likewise the old complex bicameral form of municipal government, patterned after our Federal government, has seemed in many instances at least to have proven unsatisfactory, due partly to lack of centralized responsibility.

After the great storm in Galveston in 1900 the so-called commission form of government came into existence. This combined the legislative and administrative functions in a small elective council consisting usually of five members. When adopted later in Des Moines, it was given much publicity and became known as the Des Moines plan. This idea spread rapidly and in a decade and a half it had been adopted in nearly 300 cities.

The commission plan, however, did not solve the municipal problem. The next general step has been the development of the so-called city-manager plan. This is copied from the large private corporate organizations, the small elective council corresponding to the board of directors and the city manager, appointed by the council, corresponding to the general manager of the corporation. He carries out the entire administrative functions of the city government, the council being the legislative and policy-determining body. This plan started in a preliminary way in Staunton, Virginia, in 1908 but gained no momentum until adopted in Dayton in 1913 after the disastrous flood there. It has now been adopted in 287 cities, distributed thru 38 states. The most noticeable addition to the list is, of course, Cleveland with a population of 800,000 where, however, it does not go into actual operation for another year. The other cities in Ohio having this form of government are Akron, Ashtabula, Cleveland Heights, Dayton, East Cleveland, Gallipolis, Lima, Middletown, Painesville, Sandusky, South Charleston, Springfield, Westerville, and Xenia.

The city-manager plan of government was discussed at the annual convention of this Society ten years ago. There was some sentiment expressed that such discussion bordered on the political but the writer could hardly be expected to review recent municipal legislation without touching upon this outstanding development.

SHOULD MUNICIPAL ADMINISTRATION BE PROFESSIONALIZED

Dr. A. R. Hatton, Department of Political Science, Western Reserve University, Cleveland, Ohio

I am glad that the chairman did not introduce me as professor because now, when I am so introduced, I feel that I am getting something under false pretenses. I "professed" two hours last year, two hours the year before and so far this year I have given no University lectures at all. However, I am still connected with a University faculty and regard myself as a University man.

During the last five years I have found myself drawn more and more away from regular university teaching and into contact with practical municipal problems; not the sort of physical and engineering problems in which you gentlemen are most interested, but with the equally important problems of municipal organization. I suppose that it was on account of this experience that my friend, Mr. Barlow, of New London, asked me if I would come before you this autumn and speak on some question of municipal organization. At that time I suggested that I would prefer to discuss the subject announced by your chairman, "Should Municipal Administration be Professionalized." I wanted the question stated "*should* municipal administration be professionalized" and not "*can* it be professionalized," because I assume that if municipal administration ought to be put on a professional basis it can be done and ultimately will be done. My purpose in presenting this subject is to promote discussion and offer suggestions rather than to draw any very dogmatic conclusions.

In order that I may not be misunderstood I desire at the outset to define the principal terms which I shall use. By "administration" I mean that part of the municipal government which has to do with the actual execution of local policies, that division of the governmental organization which carries out the policies as distinguished from the portion of the organization which determines the policies. No one would seriously argue that those men and women who make up the policy-determining bodies of our municipalities, such as city councils and commissions, should become professional office holders. Proper representation does not require either that they should be technically trained or elected to serve during good behavior. On the other hand, the question is being more and more frequently raised in American cities as to whether the time has not come when that part of municipal government which must carry on the work of the municipality, once the policies have been determined, should not be placed on a thoroly professional basis.

What is meant when I suggest that municipal administration be "professionalized"? To me it means putting administration, as I have defined it, upon such a basis that men and women will be expected to train themselves for it; putting it upon such a basis that when appointments are made they will be made from persons who have had special training for the positions to which they are named and that, once appointments are made, those appointed will continue in the positions so long as their administrative duties are satisfactorily performed. In other words, it will mean placing municipal administration in such a position that men and women may be expected to prepare for it as a career just as they now prepare for other professions.

I realize that in addressing this organization I am speaking to many who have been professionally trained, usually in some phase of engineering. I do not need tell you that, so far as engineering is involved in municipal administration, it is already pretty widely recognized that professional training is desirable. The same is rapidly becoming true of public health administration, in which at least medical training is regarded as necessary and especial training in public health administration is desirable.

But, if municipal administration is to be professionalized in the sense that I have indicated, we must go further than merely to require professional training for individual phases of the work such as engineering, health and sanitation. If municipal administration is to be successfully professionalized, even as to these special activities, such professionalization must also include the head of the administration. Under present conditions men who have been trained as engineers, or for work in health and sanitation, hesitate to accept positions with municipal governments because the head of the administration, being politically chosen, is likely to be frequently changed, thus involving a probable loss of position to those in charge of even the most technical and special municipal services. Since persons who have gone to the trouble and expense of acquiring a professional training have a right to look forward to earning their bread and butter with as little hazard as possible, many of them hesitate to accept municipal positions because, in thus leaving the field of private practice, they break connection with their private clientele and make it difficult to return to private work if, thru some turn of the wheel of political fortune, they are thrown out of their municipal positions. As a result of this uncertainty we are forced to admit that, even in those municipal positions where engineering training is expected, municipalities have usually had to content themselves with engineers of second or third rate ability.

The situation that I have just stated can probably be changed only by placing the head of the administration in a position where we may expect him to be professionally trained and to have that security of tenure which professional training alone warrants. There seems to me to be no likelihood that we shall be able to secure and keep the sort of trained administrators in municipal service which the nature of municipal government now demands unless the head of the administration, upon whom their appointment and tenure of office depends, can be removed from the field of political struggle and become a professionally trained executive.

I am willing to concede that in suggesting that municipal administration be placed on a professional basis to the extent which I have described I am running counter to a long-held doctrine of American politics. You will find that doctrine laid down in one of the early messages of Andrew Jackson to the Congress of the United States. The dictum of "Old Hickory" was that the duties of public office can be made so simple that any person of ordinary intelligence can readily learn to perform them. His conclusion seemed to be that if any person of ordinary intelligence could not successfully perform the duties of a given public office it was not because there was anything wrong with the person but because something was wrong with the office. That opinion is really held today by a very large number, perhaps by the majority, of the voters in American cities. It must be admitted that in the days of Andrew Jackson there was some basis for this conclusion. Government then was a relatively simple affair. The difficulty with the Jacksonian theory is that government, particularly municipal government, has almost completely changed in character during the last fifty or seventy-five years. If you will examine the functions of American city governments, even fifty years ago, in comparison with the functions of today, you will discover that the American city of today is more unlike the American city of fifty years ago than the city of that time was unlike the European city of the middle ages.

I recall that a few years ago President Eliot of Harvard said that he could personally remember the time when all the important functions now performed by the government of the city of Boston were first undertaken. He mentioned in that connection the introduction of systematic street lighting, the public water supply, gas and electric light, and the coming of pavements other than of cobblestone,—all that within the memory of a man now living. It will be noticed that these phases of municipal government include practically all of those which depend for their successful operation upon technical knowledge and long training and experience in that sort of work. Take away such functions of municipal government and practically nothing would remain which the people of American cities have now come to associate with the necessary services of the municipality.

Is it not then perfectly clear that, if American municipalities are to perform the functions which the people have come to expect of them, the entire municipal administration must be placed on a professional basis? How can we stop with the superintendent of the water works, the city engineer and those in charge of public health when our only chance of getting the quality of trained ability which we must have, even for the successful administration of those functions, depends upon having at the head of the administration some person who, because of his own professional training and attitude, recognizes the importance of training and experience in his subordinates and can assure them a reasonably permanent tenure.

Let me give you an illustration or two that may serve to drive home the point that I am trying to make. I have spoken of the fact that there has been almost a complete change in American municipal government within the memory of people now living. Indeed, the major portion of that change has come within my own memory and I would not admit to being of ancient age. Within my memory street paving, in so far as the streets of American cities were paved at all, consisted mostly of macadam and cobblestones with occasionally a little of hewn stone blocks. At the time when I began to become interested in city government any person of fair intelligence could be trained in the course of half a day to lay with reasonable success the type of pavement then put down. As a farm boy I knew the whole process of laying macadam roadways and frequently supervised it on a privately owned turnpike in which my father was interested. How different that is from the situation with which we are confronted in American cities today! It is now not only necessary to have men of training and experience in the laying of pavement, but the very composition of the paving material has come to be a matter of the utmost importance if city pavements are to be successfully laid and the cities are to get even a fair return for paving expenditures. From macadam and cobblestones we have progressed to brick, granite block, concrete, asphalt, wood block, bitulithic and many other kinds of equally complex pavements and paving materials. These changes only represent the effect of our increasing scientific and technical knowledge to meet the heavy demands of modern traffic. The relatively untrained farm boy laying a macadam turnpike for the traffic which such a roadway had to bear thirty years ago might have met fairly well the needs of that time, but the untrained farm boy, or city boy, or man, placed in charge of modern paving is a ghastly and expensive joke.

Let me use another illustration which may at first strike you as being a bit extreme. I suppose that if there is one phase of municipal administration which, it is supposed, can be successfully cared for by taking men from apparently similar work in private life that phase is municipal finance. It is very generally assumed that, if we are to have a satisfactory director of finance, the thing to do is to get some man who has been reasonably successful in his private affairs, particularly in banking. Now the fact is that some of the world's worst financial advice has been given to American cities by bankers. On the whole I have no more confidence in the soundness of the financial advice given to a city by a group of bankers, no matter how sincere they may be or how experienced in the banking profession, than I would have in that of any casual group of persons who have been fairly successful in their private affairs. Sooner or later we must recognize the fact that for the successful handling of the financial affairs of a municipality it is desirable, almost necessary, to have persons who have studied and had practical experience in public finance. I have said this to a good many audiences in America including audiences containing many bankers. It is not done with the intention of disparaging the intelligence or integrity of the banking profession but merely to indicate that persons are not necessarily prepared for success in the field of municipal finance merely because they have been trained in banking. Municipal finance is a special field demanding special training and experience.

If what I have said be true, what is to be said on the other side? What would we lose, assuming that municipal administration were professionalized from top to bottom? The first and last, and indeed, the only criticism offered, is that it would be undemocratic. It is assumed that to put administration on a professional basis would mean taking control of the government out of the hands of the rank and file of the citizens. In this connection I was very much interested in the report on Legislation which, I assume, was written by my friend Mr. Barlow, in which he spoke of the New England town meeting as an exceedingly democratic institution. It happens that I drafted the charter of the city of which he is now manager. Until this charter was adopted the city of New London had had the town meeting since colonial days.

The town hall in New London is not very large. When a town meeting was to be held, those interested in some special project—sometimes it was the volunteer fireman, sometimes one group and sometimes another—intent on getting thru their program, proposition or appropriation, would pass the word around and get into the town hall first. They didn't force anybody else to stay out but, of course, when the hall was full nobody else could get in. The consequence was that, when the appropriation was to be voted on, or any other measure favored by those first in the hall came up, it was voted thru, tho a majority of the voters might be outside the hall and opposed to what was being done. That may look like democracy but as a matter of fact, in New London, it frequently resulted in a small minority controlling the most important municipal affairs. The town meeting is an excellent illustration of the principle that, when a suggestion or institution is spoken of as being either democratic or undemocratic, it is desirable to examine it not only in the light of fifty or one hundred years ago but also in the light of modern conditions.

To me democracy means not only the power and right of the majority to control the government as to its policies but also the equal right and power to get their will put into effect after they have expressed it. If this be true, in what sense can it be said that it is undemocratic to make a profession of municipal administration, provided that the administration can only carry out the policies laid down for it? I hold that it is no business of those in the administrative service of the municipality to try to force thru the policy or to control the city in matters of policy. As professional administrators they may advise in matters of policy, and their advice is likely to be received with respect, but it is not their business as administrators to say to a city council, "You must take this policy whether you want it or not," any more than it is the business of my dentist to say that I must have a tooth filled whether I want it filled or not. My dentist, as a professional man, may properly advise me that he thinks, under the circumstances, the best thing I can do with a tooth is to have it filled or extracted. I do not lose any control over my individual affairs because I prefer to go to a dentist for advice and service of that sort rather than pick up some blacksmith on the street and ask him what he thinks I ought to do with a troublesome tooth.

When men in municipal administration are there as professional men, and it is known that they are to carry out the orders that the people may give thru their council or other policy-determining agency, the people will feel, and do feel in cities so organized, that these men are just as much under their control as any other sort of administration can be. What is more, under government so organized, the people are having the additional satisfaction of seeing their will, once they have expressed it, better executed than ever before.

One of the things we most need to learn in the United States regarding political democracy is that it can only result from the union of two equally necessary constituent elements—the expression of the popular will and the execution of the will so expressed. In this country we have been keenly alive to the importance of the first, as is evidenced by our multifarious laws and ordinances and the care that we have taken to control legislation. On the other hand, until recently, we have almost completely overlooked the importance to democracy of its executive or administrative element. The result is that, among the older self-governing countries of the world, if one excepts the countries of Latin America, we have been administratively the least efficient. Apparently we have thought of efficient administration as a desirable, but not as a necessary, attribute of popular government. It seems not to have occurred to us that democracy becomes a shallow, deceitful and futile thing if, after the people, thru law or ordinance, have said what they want done, their will is thwarted in whole or in part by reason of an incompetent executive.

We need to recur to the wise words of James Wilson, spoken to the convention which framed the Federal constitution: "Good laws without a good executive are worthless." He might have added that to cause the will of the people to fail by reason of a weak or inefficient executive is as much an attack on the fundamental principles of popular government as to take away from the people the right to say what the laws shall be. This is only another way of saying that the proper administration of a policy adopted by the people is as much of the essence of democracy as the adoption of the policy in the first place.

When one remembers the necessarily technical character of the work of a city government, how can the conclusion be escaped that the only hope for the success of democracy in a modern municipality is under an administration completely professionalized. Of course, such an administration should not be permitted to assume political functions. It should have no control over the policies of the municipality except such control as may result from advice given to the council. It should be appointed without definite term, but should be subject to dismissal whenever, in the opinion of the council, its advice proves to be unsound or its administration of affairs incompetent. I am satisfied that, in the course of time, it will be found that such a system, far from being inimical to democracy, will prove to be essential to its very existence.

The extent to which we now recognize special and professional training and attainments in practically all affairs outside of public life is amazing. If I have the tooth ache I go to a dentist. If I feel ill I go to a physician. If I want a house built I call in an architect. If I want carpentry done I get a carpenter. This doesn't mean that my dentist, or my physician, or my carpenter or my architect, control me. It simply means that in this modern age progress is build on specialization and we pick out a specialist to advise us as to what should be done and to do the thing that we want done. If we don't like the advice of our specialist we don't take it and if they fail to do to our satisfaction the things we decide are to be done we don't quit chosing specialists, we merely change them. It seems to me to be inevitable that the same practice must be established in municipal administration unless we are willing to see democracy fail in our cities; and failure there means failure everywhere, for a majority of our people now live under urban conditions. I do not believe that democracy is going to fail, nor do I believe that its problems will solve themselves. I am convinced that, however reluctantly, democracy will ultimately call into and keep in its service persons with the special ability, training and character which its problems require.

In a report read this morning someone quoted the often repeated observation of Bryce in his American Commonwealth that the cities represent the one conspicious failure of American government. There is a measure of comfort and reassurance in the fact that, in his work on Modern Democracies, appearing just before his death, Lord Bryce qualified to a considerable extent his original statement regarding the government of our cities. In this last of his published works he states that great progress has been made in American city government since the American Commonwealth was written, and he calls particular attention to the fact that this progress has come thru the very means that I have discussed before you today, thru the increasing use of professional training and experience in municipal administration.

It is certainly safe to say that our cities are no longer our conspicious governmental failure. That bad eminence now clearly belongs to the American county. Moreover, there are now many cities whose governments are far better conducted than that of the nation or of any of our states. It is a striking confirmation of the point of view that I have tried to present that practically all of these more advanced cities approximate in their organization the principles that I have endeavored to set forth. Whatever the condition of our cities may have been more than thirty years ago when the American Commonwealth was written, or however long the path may be which they must yet travel toward efficient democracy, the fact remains that, in political and administrative progress, the cities are today leading the county, the state and the nation. This, again, should afford us some comfort and reassurance for, whether we would have it so or not, the city is the key to our entire political future.

If by what I have said I have succeeded in bringing out any differences of opinion or in starting a discussion on the subject which I have tried to present I shall have served the purpose that I came here hoping to serve. I assure you that I am very much more interested in getting the reaction to these ideas of men actually in municipal service, particularly of men who are professionally trained, than I am in forcing any conclusions of my own upon you.

DISCUSSION

NELSON P. LEWIS: I am mighty glad Doctor Hatton gave you the kind of talk he did; I wish we had more of them. Of course, when we talk about professionalizing city administrations most of us here have in mind the use of the professional engineer to a greater degree than he has hithertofore been used. I think we must admit that many have thought it to be the duty of the trained engineer simply to carry out policies formulated by somebody else, and Doctor Hatton appears inclined to believe that this may be the proper function of the professional administrator or engineer. That is true to a certain extent, but I don't accept it as wholly true.

The idea that the function of the municipal engineer is to do what he is told, when he is told and because he was told is gradually passing. He is called upon for advice as to the engineering features of municipal improvements and he should consider that the manner, let us say, of financing such projects should be included in the engineering analysis.

I am sorry to refer to a rather personal connection of mine in my own city, but in the city of New York—this may be contrary to the opinion that some of you may have held, and I could refer to another city in New York,—I don't believe that the political affiliations, if there have been any, of engineers doing important work have been a subject of question. I refer to Rochester.

In New York for years past on rather important questions, I wouldn't say general civic finance, but "How are you going to finance this particular improvement or that?" such as the acquisition of property for parks, for a boulevard, infinite difference of opinion as to how the cost should be raised have developed. There is one determining party and that is our Board of Estimates. The policy for years has been that they can not act without the advice of the engineering department. The engineering adviser has for years past made his own recommendations and made them pretty firmly, I think, as to how much of this cost ought to be borne by the city, how much ought to be assessed upon a local area, or spread over a secondary area. Sometimes they don't take that advice, the pressure is sometimes too strong, but as a rule that advice has been taken.

Now I say that it is the duty of engineering advisers to bodies of that kind, municipal or county or state boards, to advise them frankly as to what they think is the equitable and righteous way of financing, for instance, it may be a system of state highway. If they are issuing bonds for fifty years to lay a street surface which is only going to last ten, the engineer should lift his voice and protest even if he loses his job for it.

Dr. Hatton: I want to add a word in confirmation of what has been said. I have observed that the engineers, who as a class already have the most solid professional standing in municipal administration, can speak more plainly to municipal councils, and that their advice is very much more likely to be taken, than is that of some one, such as a politically chosen mayor, who is supposed to have the right to tell the council what must be done. My observation has also been that a city manager, who can only advise, is likely to have more influence with his city council than a mayor who is regarded as superior to the council and entitled to speak to it with authority. This is the result of my observation in hundreds of cities in the United States. My conclusion is that when the professionally trained man gets himself into the position where it is understood that he is speaking as a professional adviser, with no axe to grind and no political considerations to be kept in mind, and when it is understood that he cannot force his opinion upon the council, it is only then that the professional man really begins to come into his own. His opinion then tends to become more and more influential with those who must assume final responsibility for deciding what is to be done.

What I meant, Mr. Lewis, by saying that professional administrators should not attempt to determine municipal policies was that, if municipal administration is to become a profession, it cannot be given those political functions implied in the right to veto legislation or to demand that a particular policy be established. The professional administrator is in the strongest position when it is known that all that he can do in matters of policy is to advise and not command. He should only be able to say to the council, "My advice is so and so and these are the reasons," the council knowing that it is entirely free to accept or reject advice so given and also knowing that the administrator will loyally carry out any policy that they may finally adopt.

REGIONAL PLANNING: REPORT OF THE COMMITTEE ON CITY PLANNING

Nelson P. Lewis, Chairman, New York City

There has heretofore been a disposition to confine city planning studies to very limited areas. This has been due in part to habit; those responsible for the planning have been accustomed to a restricted, not to say a parochial, attitude toward this subject. Nor was this unnatural in view of the fact that the first attempts at what was called 'City Planning' in this country were almost wholly confined to a few high spots, such as the creation of civic centers, systems of boulevards, or something more or less spectacular, which would gratify local pride and have some advertising value for the town. In all cases the corporate limits of the city or town were the ultimate boundaries of the imagination of the planning authorities.

There was another reason for this contracted horizon and that was the strict legal limitation of the jurisdiction of the local authorities within the red lines showing the city limits. There is now a realization that such restrictions are inconsistent with wise planning. The first attempts to extend the powers of local authorities were in the nature of prohibitions expressed as "thou shalt not" or the familiar "verboten." Owners of real estate, for instance, were told that they could not cut up their acreage into streets, blocks, and lots, and offer it for sale unless the plans for such subdivisions should first have been approved by some designated authority, while offices of public record were forbidden to accept for filing any plans which did not bear evidence of such approval. At first such regulations applied only to property within the limits of specified cities but this was soon followed by a long step forward in giving some municipalities similar control over the development of property outside of their boundaries but contiguous thereto or within a certain number of miles. Progress in this direction was indicated in a report submitted by the writer at the last Convention of the Society. These steps indicated that those responsible for city planning were beginning to think in larger units. If it is desirable that a city should exercise some control over the development of property outside its limits, either within or without those of another jurisdiction, why should not the officials of contiguous or nearby towns sit down together and plan for their future development, or create some machinery by which such joint planning can be done? But there are legal limitations which make it difficult to accomplish anything in this way, and some of the most important planning projects yet undertaken have been the result of volunteer efforts by groups of individuals or quasi-public organizations, generally with, but sometimes, in their initial stages, without the sympathetic interest and coöperation of the municipal authorities.

In various parts of the United States there are groups of cities and towns whose interests are so closely related that it is impossible to plan for one of them without considering the others. Such a group includes Boston and about two score cities and towns within the district tributary to it. Many reports, some of exceptional value, have been made by special committees and commissions, looking to the comprehensive development of this entire district, yet nothing has been accomplished because there has been no machinery for the official adoption and execution of such plans. The Commonwealth of Massachusetts has created certain Metropolitan Boards and Commissions, lately combined in a single Metropolitan District Commission, having jurisdiction over the water supply, the main drainage, and the parks of the entire district, but when it comes to planning for the future development of the towns themselves and their relation to each other, where coöperation or joint action is especially needed, each community is left to go its own way without regard to what its neighbors are doing.

Buffalo has, by vote of its citizens, authorized the City Council to adopt plans for the location and grouping of the public buildings and a group of citizens, under the name of "The Buffalo City Planning Association, Inc.," has brought about a study of Buffalo, not only as a city of well over half a million population, but as a part of the great Niagara Frontier District. This district affords an excellent opportunity for regional planning, involving even international problems, as the plans must necessarily include connections with the Canadian side of the Niagara River.

Early in the present year a Los Angeles County Regional Planning Conference was held, from which it appears that the progressive people of this county realize that, although Los Angeles has, by its various annexations, become the largest city territorially in the world, something more is needed to insure a consistent development of it and of the other cities and towns in this great county with respect to each other.

A persistent but unsuccessful effort to effect, by statute, a consolidation of a number of separate political units into one city was that to combine the towns on the east side of San Francisco Bay in Alameda County. These efforts, however, were it is understood, confined to the attempt to make a single political unit and whether, had it been successful, it would have been followed by the creation of machinery to plan for the development of that unit, as a whole, cannot be stated.

By far the most comprehensive project of the kind which has yet been undertaken is "The Plan of New York and Its Environs" in which it is proposed to include an area of no less than 5500 square miles, located in three states, with a population of approximately 9,000,000 according to the census of 1920. It will include, in addition to the present City of New York with its five counties, five additional counties and portions of two others in New York State, eight counties and part of a ninth in New Jersey and a portion of one large county in Connecticut. The special difficulty and the delicacy of the problem is largely due to the fact that there are within the area under consideration nearly 400 different political units, states, counties, cities, towns, villages, boros and townships. No one municipal corporation could undertake the preparation of a plan for such an extensive area without arousing jealousies and the suspicion of imperialistic designs upon its smaller neighbors. It follows that a project of this magnitude can be undertaken only by an institution or a group of individuals who have no official connection with any of the political units which would be affected. The Trustees of the Russell Sage Foundation, which was established for the express purpose of "The Improvement of Social and Living Conditions," concluded that one of the most effective ways in which this object could be promoted would be thru the preparation of a comprehensive plan for the future development of the district of which New York is the center. A Committee on Plan of New York and Its Environs was appointed under the Chairmanship of Mr. Charles D. Norton, who had been so successful as first Chairman of the Plan of Chicago in starting that great project on its way. The first public announcement of the purpose of this committee was made at a meeting in New York City on May 10, 1922, at which some notable addresses were made and Mr. Norton briefly outlined the work which had already been done and what the committee hoped and expected to accomplish. Very brief extracts from several of the addresses made on the occasion will indicate the reaction of the speakers to the proposed plan. Mr. Herbert Hoover said: "The vision of the region around New York as a well planned location of millions of happy homes and a better working center of millions of men and women grasps the imagination. A definite plan for its accomplishment may be only an ideal. But a people without ideals degenerates—one with practical ideals is already upon the road to attain them." Miss Lillian D. Wald said: "This seems to me a most important first step towards the most important undertaking that I have heard of for many years. I believe that if it is carried out in logical sequence it will add greatly to the happiness of the people of New York. It links a practical, workable plan with the vision of a city conceived in understanding of the needs of many people, their homes and those matters most closely related to their daily life." As indicating the necessity of ignoring arbitrary political boundaries in making such a study, Mr. Elihu Root said: "A city is a growth. It is not the result of political decree or control. You may draw all the lines you please between counties and states, a city is a growth responding to forces not at all political, quite disregarding political lines. It is a growth like that of a crystal responding to forces inherent in the atoms that make it up."

There is probably no precedent for the manner in which the problem is being attacked "with a view," as Mr. Norton stated in his address, "to developing and recording those basic facts and fundamental considerations which are requisite to inform public opinion and to guide the future city planners." The Physical Survey, which consists largely of an inventory, had already been started. This includes the mapping of existing topographical and other conditions, showing all transportation facilities by rail, water and highway, parks and recreation spaces, public utilities already developed such as water supply, main drainage, lighting, disposal of wastes, etc., public and quasi-public buildings, density and distribution of population, and whatever local schemes for improvement may be contemplated or in progress. All of this is to be supplemented by an Economic and Industrial Survey containing an analysis of the fundamental reasons for the existence of this great center of industry and commerce and an inquiry into the economic and occupational activities that create populous districts and those that follow population. There is also a Legal Survey to include the study of existing laws in the several states, or their subdivisions, which control or affect a plan for the area, with an analysis of the laws governing zoning, excess condemnation, the stabilization of official city maps, shore rights and land under water; and finally there is also under way a Survey of Social and Living Conditions, with studies designed to bring to the attention of those charged with the formulation of the ultimate plan those factors which have a direct bearing upon human values and social welfare and make for healthy and satisfactory home surroundings, efficient work, and wholesome leisure time.

The great concentration of population about New York may be a source of pride to those who like to think and talk of it as the largest city in the world, but it involves many very serious physical, economic and social problems. In studying the past and probable future population on the total area it has been divided into three districts: (1) designated as the urban district and consisting of the present city of New York, with Hudson County and Newark in New Jersey, having an area of about 360 square miles; (2) the suburban district, including all of Nassau and Westchester Counties in New York, all of Union County, Essex County (outside of Newark) and portions of Passaic and Bergen Counties in New Jersey, and the eastern part of Fairfield County, Conn., having a combined area of about 1170 square miles; (3) the remainder of the total area, comprising about 3970 square miles, which is called the rural district.

The increases in population during the census periods since 1850 have been plotted for each of these districts and the curves projected forward to the end of the present century. From them it appears that the urban district, which in 1920 had a population of 6,700,000, will in 1960 contain 13,000,000 and in the year 2000, 20,000,000. The suburban district, having 1,360,000 in 1920 will have 5,100,000 in 1960 and 13,000,000 at the end of the century. The rural district had some 940,000 population in 1920 and if its past rate of growth is continued it will have 1,900,000 in 1960 and 4,000,000 at the close of the century. The total population for the entire area at these different times is or is likely to be 9,000,000, 20,000,000 and 37,000,000 respectively. If these forecasts should be verified the average density of population in the urban and suburban districts combined would be equal to the present density in the Department of the Seine, but it makes a very great difference whether such density extends over an area of 1530 square miles or over a restricted area of 185 square miles, which is that of the Department in which the city of Paris is located.

A recent and rather significant step has been taken in New York where by an amendment of the State Constitution the Counties of Westchester and Nassau, both contiguous to the present city of New York and included in the area under study by the Committee on Plan of New York and Its Environs, have been given authority to change their form of county government. Commissions have been created to frame charters prescribing the manner in which the county business shall be conducted and which presumably will provide some machinery for coöperation between the different towns and between them and the unincorporated places or the county itself looking to the future development of the territory as a whole. One of these charter commissions is known to be considering the question of a county-zoning plan. Another recent piece of legislation empowered the local authorities, in these same two counties, to adopt zoning plans for the rural districts outside of the incorporated places, this being an extension of the zoning idea which would have seemed quite improbable a few years ago.

This brief outline, describing a few of the things that have been attempted and that are being done, will indicate that the city-planning horizon is being enlarged, and that when those responsible for such planning are considering the development of street or park system, the location and grouping of public buildings, transportation of passengers and freight by rail and water, or zoning, they are thinking in larger units, are losing sight of artificial political boundaries, or in other words are trying to do Regional Planning.

REGIONAL PLAN FOR GREATER NEW YORK AND ENVIRONS

By Nelson P. Lewis, Consulting Engineer, New York City

(*A stenographic report of Mr. Lewis's address explaining the maps and work done on a preliminary study of the conditions to be met and the possibilities of regional planning with reference to the district surrounding New York City.*)

The President is holding me to my pledge that I will begin at 8:00 o'clock even if there were but two people in the room, and, as stated in the program, I propose first to present a report of the Committee on City Planning, and I have taken "Regional Planning" as a special subject for that report. You may think that I have unduly emphasized the work now in progress in the City of New York, but my excuse for doing so is that it is undoubtedly the most comprehensive project of the kind that has yet been undertaken in this or any other country.

Mr. Lewis read the report on Regional Planning printed above.

I now propose to show you some lantern slides which will give you an idea of the magnitude of the problem and the manner in which it is being attacked. The area under study covers 5500 sq. mi. with a population of about 9,000,000 people, of which over five and one-half millions are in the present city of New York, about three-quarters of a million within New York State outside of the city, nearly two and one-half millions in New Jersey, and almost 300,000 in Connecticut. The district studied extends some 60 miles up the Hudson River, and between 40 and 50 miles into New Jersey, includes all of Long Island and extends to Bridgeport, Conn. (Fig. 1). Of course the population is very unevenly distributed over this area. The densities per square mile are very great in certain districts, running well over 300,000 in portions of Manhattan Island, while in some counties in the hills of New Jersey, or the valley of the Hudson, the average density is less than 50 to the square mile, and, strange to say, in some of these places the average population to the square mile in 1920 is little more than half of what it was in 1850. It is always difficult to make predictions as to future population but we must hazard an estimate.

The area has been divided into three districts; the urban district, including the present city of New York and the most densely populated portions of New Jersey; the suburban, including territory immediately adjacent to the greater centers of population; and the rural district, covering the remainder. If we plot the

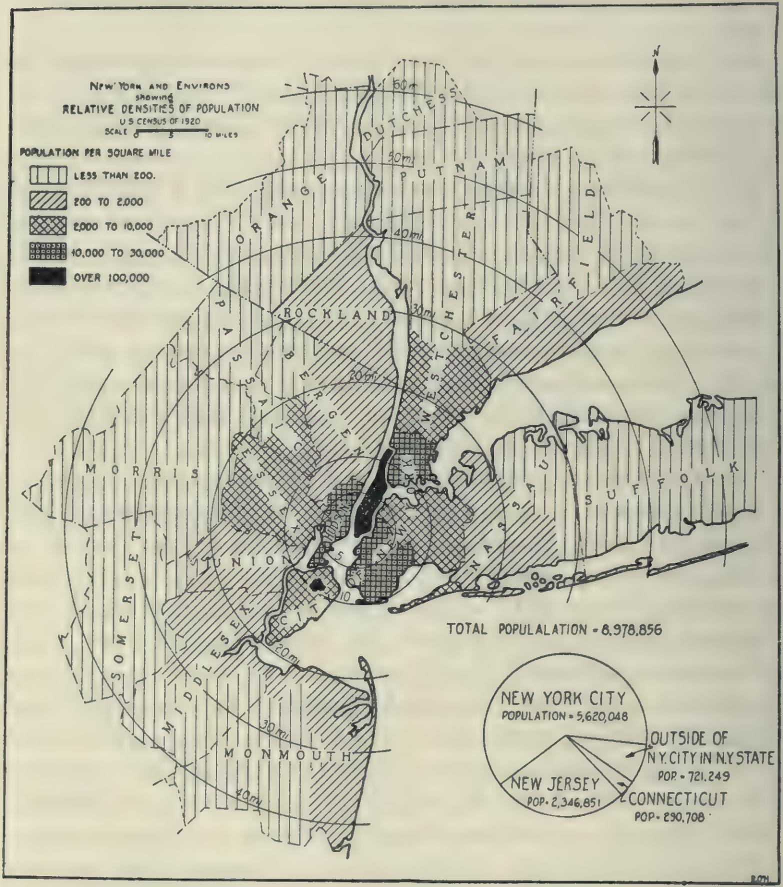


FIG. 1. RELATIVE DENSITIES OF POPULATION, U. S. CENSUS OF 1920

population of these several districts from 1850 to 1920 and project these curves forward in what is believed to be a conservative way, it would appear that at the end of the present century the population in the urban group will have reached 20,000,000, in the suburban group 13,000,000 and in the rural group 4,000,000 a total of

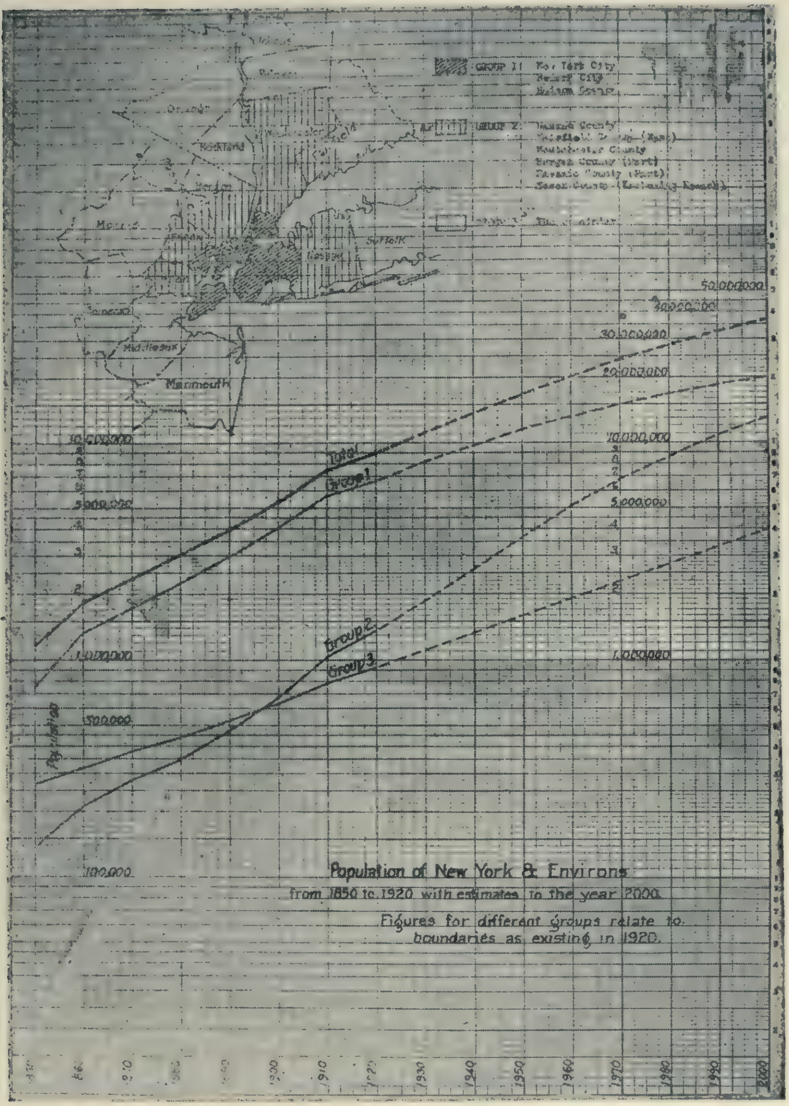


FIG. 2. POPULATION OF NEW YORK AND ENVIRONS, 1850–1920—2,000

37,000,000 of people (Fig. 2). Perhaps you will realize better what this means when I say that the total in this district would, at that time, equal the present population of all of New England

and of all the seacoast cities south as far as Georgia, including New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and the two Carolinas. I hope this forecast will not be verified, but unless something now unforeseen will tend to change the habits and customs of our people, and check what appears to be the irresistible drift toward the big cities, I fear that the case has not been over-stated.

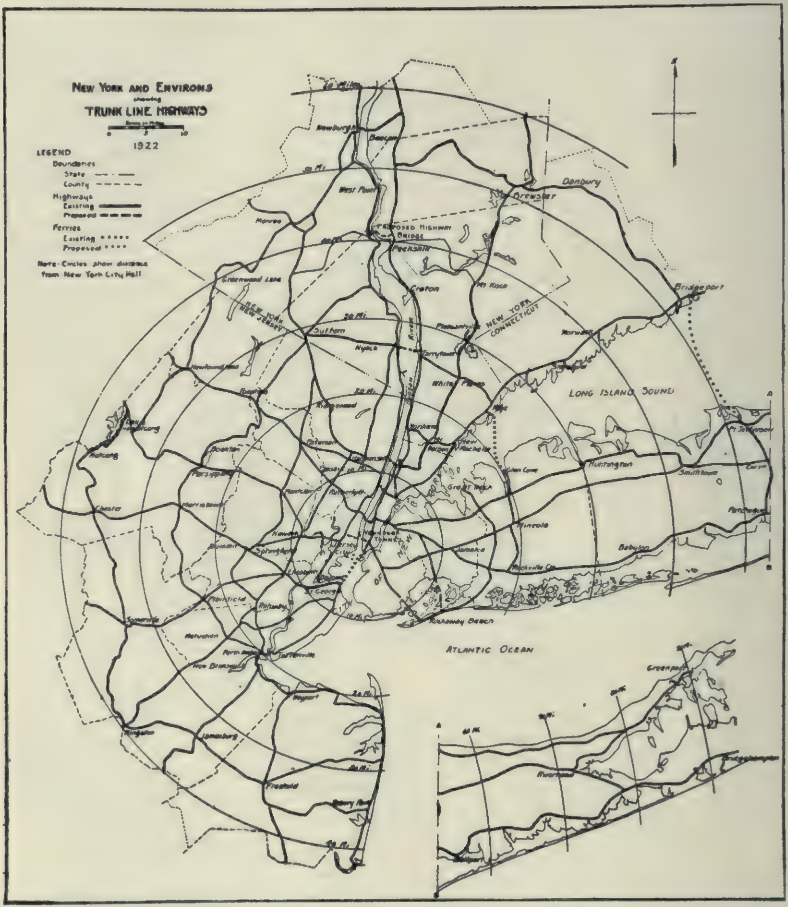


FIG. 3. TRUNK LINE HIGHWAYS, NEW YORK CITY AND ENVIRONS

Now let us look at the facilities for communication between the central and outlying portions of this area. The highways come first; ignoring the intricate system of tributary roads, what might be called the trunk line highway system is shown by figure 3. At first glance it does not appear that out of this could be resolved any symmetrical diagram such as is usually shown in planning studies, and yet you will note that there is a main axis, consisting of the Albany Post Road down the east side of the Hudson, Broadway traversing Manhattan Island, the ferry to

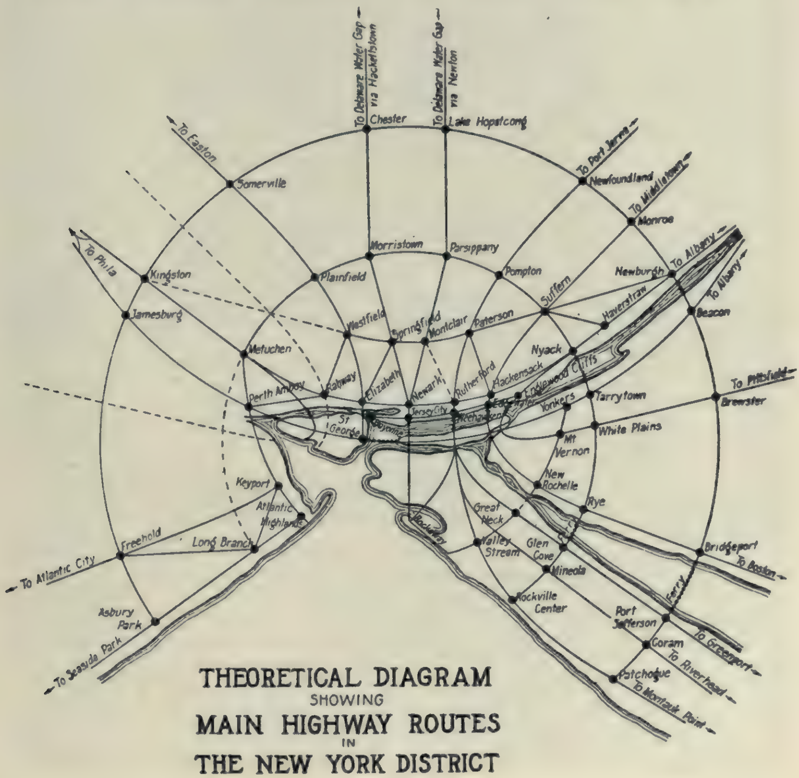


FIG. 4

Staten Island, and the old Philadelphia Coach Road to Perth Amboy and thence across New Jersey to Philadelphia. There are also approximations to the curves leading into and out of the central area which are usually shown on such diagrams, and it is also possible to trace at least two circumferential roads so that without taking undue liberties we may deduce the theoretical diagram shown as figure 4. Of course the roads are not as regular in alinement as the lines on this diagram, but they are there and the diagram suggests where certain straightening and certain missing connections are needed.

But the great majority of people, whether visiting the central portion of the area occasionally or coming in for their daily work as commuters, will depend upon the railroads, and the distance from the place where they spend their days to which they can go to establish wholesome homes for their families will depend upon the cost of commuting. Figure 5 shows the network of railroads serving the district, and it shows also the distance to which the commuter can go for various fares, these being indicated for 5¢

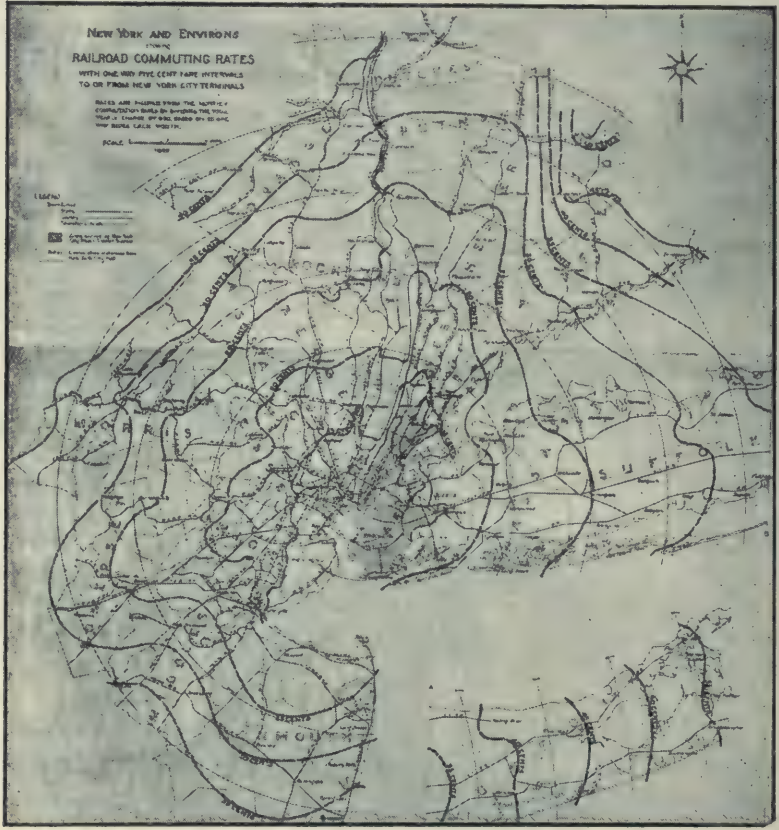

NEW YORK AND ENVIRONS
RAILROAD COMMUTING RATES
WITH ONE WAY FIVE CENT FARE INTERVALS
TO OR FROM NEW YORK CITY TERMINALS
SCALE

FIG. 5. RAILROAD COMMUTING RATES, NEW YORK AND ENVIRONS

intervals, based upon the one-way fare under the assumption that the yearly commuter whose case we are considering will not have a long vacation but will be obliged to come to the city 300 days in every year. You will notice the irregularity of these curves and your attention will be attracted to the fact that the crossing of the Hudson River and East River is an expensive operation and that whether this is done by bridges, tunnels, or ferries, it adds materially to the cost of the service.

If we are to have a healthy and contented population, we must provide reasonable facilities for recreation. The scale of any map of the entire area makes it possible to show smaller open spaces only by symbols, and the reproduction of such a map, whether on the screen or on a printed page, is quite unsatisfactory. In some portions of the district the park spaces are quite generous, in others they are very meager. In percentage of total area devoted to improved parks, the Boroughs of Manhattan and the Bronx, in New York City, and Essex County, N. J. lead, having respectively had 11, 15 and 4.5 percent of their area devoted to this purpose. When it comes to proportion of park spaces to population, the Borough of the Bronx and Essex County easily lead, with Westchester, Richmond and Queens County, N. Y., and Fairfield County, Conn. following in the order named. In this and the preceding comparison Rockland and Orange Counties are omitted as their very large percentages of park areas include the great Palisades Interstate Park.

There are other open spaces which some day may be available for public recreation. The many reservoirs forming part of the public water supplies are really a series of very beautiful lakes. Of course free use of them for boating, fishing, and occasionally a surreptitious swim, could not be permitted. An effective sanitary and police patrol, which would be necessary to guard against pollution if the shores of these reservoirs were to be made available for public enjoyment, would involve large expense, and yet the benefits which would result from the permission of such use would be so great that such sanitary supervision will doubtless be undertaken.

There are other areas which while not available for public recreation are likely to remain as permanent open spaces, viz. cemeteries. In some communities cemeteries have actually been acquired, abandoned for the purpose for which they were originally designed and converted into public parks. There are several such cases in Paterson, N. J., while in San Francisco large cemeteries have, without the removal of any bodies, had their mounds leveled off, single monuments substituted for the smaller stones to indicate the use to which they were originally put, and are now public playgrounds. This use may now be repugnant to the

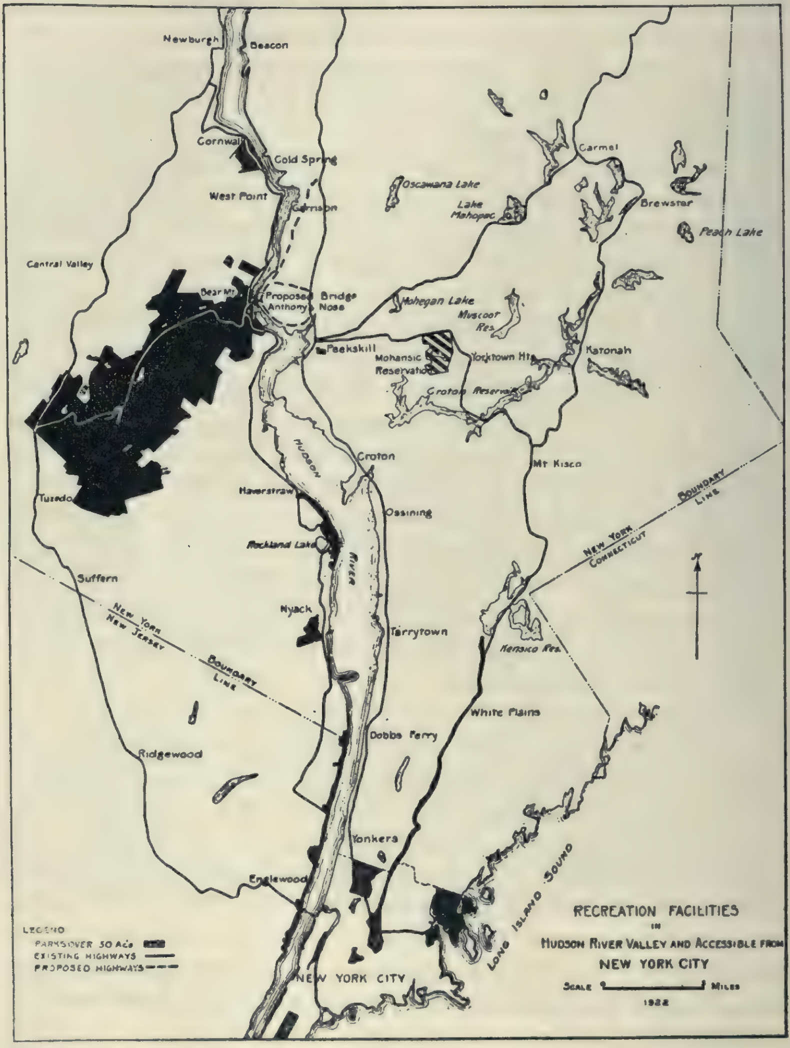


Fig. 6

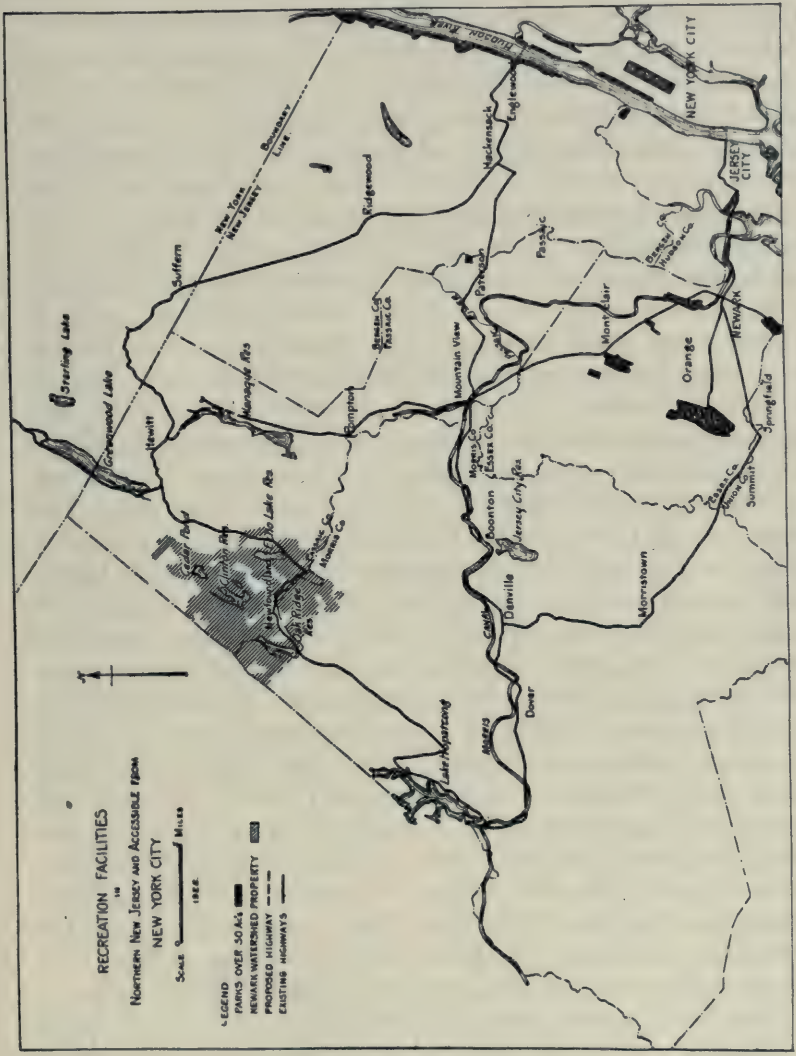

RECREATION FACILITIES
IN
NORTHERN NEW JERSEY AND ACCESSIBLE FROM
NEW YORK CITY
SCALE
MILES
LEGEND
PARKS OVER 50 AC'S
NEWARK WATERSHED PROPERTY
PROPOSED HIGHWAY
EXISTING HIGHWAYS
Sterling Lake
Greenwood Lake
Hewitt
Suffern
New York
New Jersey
Boundary Line
Ridgewood
Hackensack
Englewood
Hudson River
NEW YORK CITY
JERSEY CITY
Cedar Pond
Clinton Res
Oak Ridge Res
Newfoundland
Echo Lake Res
Wanaque Res
Pompton
Bergen Co
Passaic Co
Mountain View
Paterson
Passaic
Bergen Co
Hudson Co
Montclair
Orange
NEWARK
Springfield
Summit
Essex Co
Union Co
Morris Co
Essex Co
Boonton
Jersey City Res
Danville
Morristown
Canal
Dover
Morris
Lake Hopatcong

FIG. 7

feelings of the great majority of the people, and yet such conversion of use may be taken as a matter of course in another generation.

The portion of the area under consideration on both sides of the Hudson, with its present and possible recreation facilities, is shown in Fig. 6, which also indicates the principal highways, including the proposed new bridge across the Hudson from a point just above Peekskill to the Bear Mountain Inn. There is no highway bridge at present south of Albany. The existing ferries are so taxed during the summer season that there have been instances where motor cars have had to wait in line until the early morning hours before they could be carried across the river. It would be an inestimable advantage if vehicles could cross the river at some place above New York City without the delays incident to ferries and avoid going thru the dense traffic of the central area, and if that central area could be relieved from a large amount of additional traffic. A remarkable opportunity for adding to the present recreation facilities of the district is presented in the Morris Canal, extending from the Hudson River at Jersey City to the Delaware River at Philipsburg, by way of Lake Hopatcong. The charter of this Canal, granted in 1823, is about to expire, and under it the State of New Jersey can acquire the Canal and all its rights, but if this is not done within a year the charter will be automatically extended for another half century. While of no commercial value, the Canal passes thru very beautiful country and is admirably adapted for boating and canoeing and, if acquired by the State and incorporated in the present recreation system, it would be of very great public benefit. The Canal and its relation to some of the existing parks in New Jersey, and to its lakes and reservoirs, is shown by Fig. 7, while its connection with the great Bear Mountain Reservation is shown on that and the preceding figure, which also indicates the location of the Bronx River Parkway, extending from Bronx Park northwardly along the Bronx River to the foot of the grest Kensico Dam, of New York City's water supply system, a few miles north of White Plains.

(*Mr. Lewis showed views of a number of old buildings in the present city of New York and contrasted them with existing conditions at the same places. He emphasized the great aid to city planning afforded by aerial photography and concluded with some views of the system of reservoirs in connection with New York's water supply system, going even as far as the Ashokan Dam and aerating fountains in the Catskills.*)

THE TECHNIQUE OF AERIAL SURVEYS

By A. T. Abernethy, New York City

(*A report of an address illustrated by lantern slides indicating the nature of the valuable information conveyed in the descriptions of the pictures.*)

I am going to try to show you how to use aerial photographs. I shall simply endeavor to show you what we are able to do with aerial photography, the class of work that we are in a position to make and deliver.

Aerial photography is divided into two classes; first, oblique pictures, such as Mr. Lewis has shown, and second, the map or mosaic picture.

The oblique is simply a perspective view of the same nature as any other photograph, except that it is of greater vision. It is taken from a greater altitude and takes in more area.

The map picture is a series of photographs which are taken, matched together in the engineering room, and then recopied. This forms an absolutely true scale map which shows the detail with the added advantage of having everything that any line map could give. It also has the cultural data that practically no ground survey could give. City-planning commissions, city engineers, men connected with planning work, are really the big users of it, altho I believe every city department can use such maps.

The big advantage is that you can get these data at much less cost and in much shorter time than any ground survey methods would allow.

The best we can do now is to look at some of the pictures. When we get thru I suggest that you look at some of the actual work which I have placed around the room. The various scales are marked and you can see more closely and tell more definitely what the work would show you in your office.

Mr. Abernethy showed views of the Statue of Liberty, the National Capitol, the House and Senate Office Buildings, Pennsylvania Station, several private estates, Manhattan Island, and Boston. The view of the upper east side of New York showed the density of population very well; that the planning of the streets was all right, but there was not space enough left after they had been laid out and built upon. One picture included Brooklyn, Manhattan, the bridges between them, together with Jersey City and the various railroad yards, the view taking in territory as far back as Newark.

Columbus Circle showed the various types and classes of buildings around it, boarding houses, rooming houses, office buildings here and there, apartment houses, and higher grade residences. It furnishes food for thought for the city planners. There was also a study for traffic at Columbus Circle looking all the way down Broadway, showing the automobile parking at the side streets.

The picture of Jersey City is being used in connection with the bridge and tunnel work. They are laying out additional viaducts.

A series of pictures was taken of all the Erie railroad property in Greater New York and the Metropolitan district. Shortly after they were finished fire destroyed three of the docks. They said that the possession of the aerial photographs facilitated a very speedy and equitable adjustment with the insurance companies. They had the exact conditions of the properties before they were burnt.

An undeveloped area, now under rapid development, Port Newark Terminal was shown. They are dredging channels to the warehouses along the inlet. The undeveloped area is available for factory sites.

A picture north of Long Island City showed the Queensboro bridge, Hellgate bridge, together with the Pennsylvania railroad just before it goes under water into New York. This picture affords a visualization of that territory which no amount of walking over it would give, showing the relation of all the existing buildings, and the open lots, making decision on any contemplated action much more ready and certain.

Views of Columbia University, the heart of the city of Newark and several suburban towns, such as Montclair and Bloomfield, gave an idea of the general relation of everything in small urban districts and in small towns.

A picture used in merchandising work presented an idea that might be used in city planning in getting points to the citizen. A city-plan ordinance or program must be sold to the citizens.

Unless the majority is in accord with you it is not easy to succeed. In this picture the potential sales value of each of the buildings was pointed out,—the apartment house was good for $500 to $1200 of electrical equipment, the carpenter and builder is good for $25 to $250 of business, etc. You can use the same idea in your city planning by bringing your lines down to point out that this building or this certain area has a certain number of people in it, or it has a certain condition which should be treated in a certain way. It is a very good way of graphically portraying what your problem is and what your treatment will be.

The camera used was shown on the screen and its use described. The camera is automatically operated by a small electric motor. The intervals of exposure are set on the dial. The photographer's function is very slight in connection with the actual operation of taking the pictures.

Mr. Abernethy showed a picture illustrating the manner of taking pictures. He also showed a picture illustrating the method of plotting the map.

CONTROL OF PROPERTY SUBDIVISIONS

By Edwin A. Fisher, Superintendent of City Planning, Rochester, N. Y.

The Committee on Local Subdivisions in its very comprehensive report published in the Proceedings of the 1921 Convention, said "Rochester, N. Y. appears to have, thru its Bureau of City Planning, and the unusual powers given to that Bureau, a better control of property subdivisions by private individuals or corporations than any other city from which information was secured."

A brief description of the work of the Bureau in local property subdivisions during the four years of its existence may be of interest.

The city has a population of over 300,000 and an area of about 30 square miles. It is a city of the first class, having its own city charter. The charter sharply separates the legislative from the executive functions of the city government. The legislative power is vested in the Common Council; the executive power is vested in the Mayor who appoints the heads of all departments without term or confirmation, excepting the city comptroller, the city treasurer and heads of the school board. The members of the several departments appoint the bureau heads under similar conditions.

The City Planning Bureau is a bureau in the Department of Engineering. The superintendent is a part of the executive department of the city administration. The superintendent is the executive officer of the bureau, and has the authority usually given to a commission. He can formulate and promulgate rules and regulations in relation to the laying out, acceptance and dedication of streets, and with respect to private subdivisions the charter provides that before an owner of any tract within the city can sell any portion of a subdivision he must prepare a plan which must first be approved by the superintendent of city planning and the city planning advisory board before filing in the office of the county clerk, and a copy must be delivered to the assessors.

The advisory board referred to consists of four citizens appointed by the Mayor, who serve without pay. The corporation counsel is also ex-officio a member of this advisory board.

While the authority of the superintendent is unusually complete, his action, however, is not final until approved by the advisory board.

Members of the City Art Commission may also serve as members of the advisory board. Also any officer or employee of the city may serve as superintendent of city planning, all without additional compensation.

The rules and regulations made by the superintendent, and approved by the advisory board, provide for an appeal to the board from the decision of the superintendent, the board acting in this case as a board of appeals.

The rules and regulations relating to laying out, dedication and acceptance of streets, made by the superintendent, were approved by the advisory board on May 12th, 1919. A brief statement of the requirements is as follows:

The regulations provide for standards which in all cases are stated to be general; the bureau reserving to itself the right to modify a standard when convinced that it is for the general good. The general requirements are as follows: The minimum width of any street, in general between property lines shall be 50 feet. Alleys, meaning public rights of way of not more than 20 feet, may be laid out in the rear of lots fronting on adjoining streets, when such lots do not exceed 120 feet in depth. The minimum width of alleys shall be 16 feet. The purpose of this restriction as to depth of lots is to prevent laying out lots fronting on alleys. It is also provided that the Superintendent may require wider streets than the minimum of 50 feet, where he deems necessary. Intersecting streets shall be provided so that generally no block shall be longer than 1,000 feet. Also dead-end streets are generally prohibited.

In laying out allotments provisions must be made for continuing existing streets, as may be necessary for public requirements.

Before a street will be accepted the street must be graded to a grade meeting the approval of the city engineer, and monuments must be placed to define the street lines.

Street grading, local sewers, etc., in this city are all paid for by an assessment upon the abutting property. We have therefore included a provision that if it is not desirable or possible to do the work required in order to place the streets in an acceptable condition, the streets may nevertheless be accepted, provided a bond be given to the city under the terms of which the work shall be done within the time fixed in the bond, and also further provided that the special improvements, such as sewers, water, paving and sidewalks may be provided by the owner of the land dedicating the streets, provided that such work is done in accordance with city specifications; but such improvements need not necessarily be done where the same can be provided for by local improvement ordinance after the streets have been dedicated and accepted by the city.

Another provision is that no allotment or subdivision may be approved unless it is deemed practicable by the superintendent, without delay, to supply proper water and sewerage facilities.

Profiles of streets may be required, also topographic maps, if the superintendent deems necessary.

An abstract of title, including city and county tax searches, etc., must be furnished, and so far as possible, title to the land offered for dedication must be given in fee simple absolute.

The bureau has operated since the adoption of these rules and regulations under the provisions so far cited. A large amount of time and patience are required to get property owners desiring to subdivide their land to comply with these regulations. The greatest difficulty is where the property to be subdivided should be taken in connection with other property whose owners are not ready to subdivide, or where the owners of the several pieces that should be included in one tract are not agreeable to any general plan. We have cases where it has taken at least two years of persistent work to iron out the difficulties that arise in this connection.

The amendment to the charter secured in 1920 gives to the city the power of excess condemnation. This has helped very materially in carrying out proper street lay-outs where portions of property left after cutting the street thru are not sufficient for proper size lots.

The amendment relating to subdivisions, already referred to, was passed by the Legislature in 1921. When this provision took effect we found it would be necessary to have some general regulations of the bureau so that the superintendent might approve of these subdivisions or re-subdivisions as they came in, in order to avoid delay which was very exasperating to the individuals concerned.

A new section was therefore adopted providing for the size of lots in residential sections, which reads as follows: In general the size of lots in residential sections shall be not less than 40 feet front on a street and not less than 100 feet in depth. The advisory board adopted a resolution approving of subdivisions having not less than the dimensions specified now or hereafter submitted.

Another provision permitted the approval of subdivisions where buildings had been erected prior to the passage of restrictive laws or ordinances the location of which made it impracticable to divide so as to comply with the bureau regulations. The adoption of these regulations made it unnecessary to submit every case to the advisory board and resulted in much more agreeable relations with subdividers than would otherwise have been possible.

We have found it necessary in carrying out regulations relating to city planning, especially those having to do with size of lots and with zoning, to be very reasonable and to avoid any appearance of making arbitrary decisions.

The superintendent and the employees in the bureau have given large amounts of time in explaining to the property owner the advantages of the regulations.

In the routine work of the bureau during the years 1918–1921 inclusive about 135 streets have been opened, widened, extended, or accepted when offered for dedication, and from June 1st, 1921, when the charter amendment requiring approval of subdivisions took effect, to the end of the year, over 100 subdivisions have been approved before filing with the county clerk.

While the authority of the superintendent, with reference to preparing a city plan, extends to one mile outside of the city and as much farther as he deems proper, the bureau has no authority to compel compliance with its plans or regulations. Extensive studies of the outlying portion of the city and adjacent territory have been made, and tentative plans of subdivisions mapped out. Nine separate ordinances have been presented to, and adopted by, the Common Council, for widening streets in the suburbs of the city from a general width of 49.5 feet to not less than 80 feet, and in some places 100 feet, covering about 12 miles in length.

Provisions for the Enforcement of Rules and Regulations

The original city-planning amendment to the city charter provided that a private street not accepted or opened by the city must not be lighted, cleaned, swept or sprinkled at public expense, and that water mains must not be laid or extended into the same, and sewers must not be permitted to be connected with city sewers, and a curb on the public street intersecting such private street must not be removed and the private street and intersecting street must not be connected. While this penalty was sufficient in many cases to prevent the laying out of streets contrary to the regulations of the bureau, it was not sufficient in all cases and in 1921 an amendment was secured making a violation of any of the rules, regulations and restrictions of the city-planning bureau a misdemeanor. It was also further provided that injunctions might be issued to restrain violations of these rules and regulations.

There was, however, no provision for enforcing any regulations of the bureau outside of the city.

Chapter 520 of the Laws of 1922, provides that towns adjacent to cities of the first class might adopt rules and regulations governing the laying out, dedication and acceptance of thorofares and highways. In accordance with this Act, two of the towns adjacent to the city have adopted such regulations which, so far as possible, are the same as those of the city-planning bureau of the city of Rochester. In the regulations of the town of Irondequoit they have this provision, which was inserted at the suggestion of the superintendent of the Rochester city-planning bureau.

> WHEREAS, Chapter 505 of the Laws of 1917 makes it the duty of the Superintendent of City Planning of the City of Rochester to prepare a city plan, etc., etc., covering the territory embraced within the boundaries of the City of Rochester, and within one mile of such boundaries, and such further territory outside of the city as the Superintendent may deem proper.
>
> *Therefore,* The Town Board of Irondequoit before approving of the location of highways in said town will consider the plans made by the Superintendent of City Planning of the City of Rochester, and so far as practicable, the plans submitted by the property owners shall comply with the general plans of said Superintendent of City Planning of the City of Rochester.

The New York Association of Real Estate Boards is actively interested in securing legislation making it mandatory for all towns adjoining cities to have planning boards to control local subdivisions, especially with reference to the proper location of main thorofares. A committee of this association, of which the writer is a member, is now considering this matter.

Our bureau has the active cooperation of our real-estate dealers, and very generally of the property owners, in subdivision work, both in the city and in the adjoining towns. While we have not been able in all cases to accomplish all we desired, we have, thru such co-operation and by persistent work, greatly improved conditions in real-estate subdivisions.

We have the active support of the executive department of the city government and also of the Common Council thru its public works committee, as well as that of the Chamber of Commerce and other business and civic associations. The press has also been unanimous in its support of the work of the bureau.

The generous support and approval of the work of the bureau is due also in a large measure to the high standing in the community of the members of the advisory board.

SPECIAL TREATMENTS OF THE INTERSECTIONS OF HEAVILY TRAVELED TRAFFIC ARTERIES

By Clarence W. Farrier, City Planning Engineer, Chicago, Ill.

Traffic arterial streets and roads, like all other systems, are but as strong as their weakest points. It is obvious, theoretically, that the intersections of these streets and roads with similar traffic arteries are the weakest points of any arterial system. An analysis of any comprehensive traffic survey shows that this theory is a proven fact when these streets are operating at or near their ultimate capacities.

An intersection of two streets, when the traffic volume has reached the point where policing is necessary, has under ideal conditions but fifty percent of the carrying capacity of the streets between intersections because of the delay caused by the cross-traffic interval. When intersections of three or more streets occur at one point the capacity of the intersection is still further reduced and, unless special treatment is given, a condition of stagnation is bound to exist.

There are many possible types of special treatment of these intersections. The first attempts at the treatment of important intersections were the creation of great plazas and round points. This method of handling the situation met the requirements of the past and was feasible then as to execution. Traffic was caused to rotate about these plazas and round points in one direction and under the old conditions of slow-moving, horse-drawn traffic with even a moderate sized round point this traffic had ample space to sort itself out on the circular roadway and proceed on down its respective streets. Under the modern conditions of high speed motor vehicles, more intense use of property, and heavy street-railway traffic a different condition exists. High speed motor traffic entering one of these round points in the state of congestion which exists in some of our American cities could not sort itself out, with a reasonable minimum of cross traffic interference, unless these round points were made many times larger than they were fifty years ago. It is my opinion that to be effective for motor traffic a round point treatment of a simple two-street intersection would require an inside curb diameter of about three hundred feet. The intersection of more streets would require a proportionally larger diameter.

The handling of street cars on an intersection of this kind is near to an impossibility except by grade separation. The one-track circulatory scheme shown by Hénard in diagram A, would produce a hopeless state of stagnation of this street-car traffic because of the consolidation of all of the cars into one track and the incidental delays due to working of the switches, even with solenoid operation of those switches. To place multiple tracks around this round point would better conditions only in certain special cases.

With the present condition of the intense use of land and its corresponding high values, the devotion of sufficient space to handle important intersections by means of round points is impractical and uneconomic except in special cases.

A solution of the street-intersection problem which can be applied under certain conditions is that of grade separation. This method is practical only when one street is to be separated from another or from a system of streets at their intersections. It is limited in its practical application to those intersections where there is little or no interchange of traffic between streets so separated. The creation of ramps or connecting side streets to take care of turning traffic is in most cases impractical. To instal a grade separation in an established district usually causes enormous damages to existing buildings and disrupts established real-estate values. If both streets are street-car streets a great inconvenience is caused to the transfer of passengers.

This solution has proved very successful in several instances where special conditions existed. A notable example in Chicago is the Michigan Avenue improvement. Here from Lake Street to Ohio Street, a distance of one-half mile, Michigan Avenue, the most heavily traveled street in the city, is carried on a viaduct over the cross streets. The special types of traffic on the avenue and on the cross streets made this grade separation successful. The traffic on Michigan Avenue is restricted to light traffic and the traffic on the cross streets is almost wholly heavy freight transfer traffic. Very little of this traffic has any reason for turning from one street onto the other and so practically no inconvenience is caused by the grade separation.

Abb. 156. Ausſteller: Architekt Eugen Hénard, Paris.

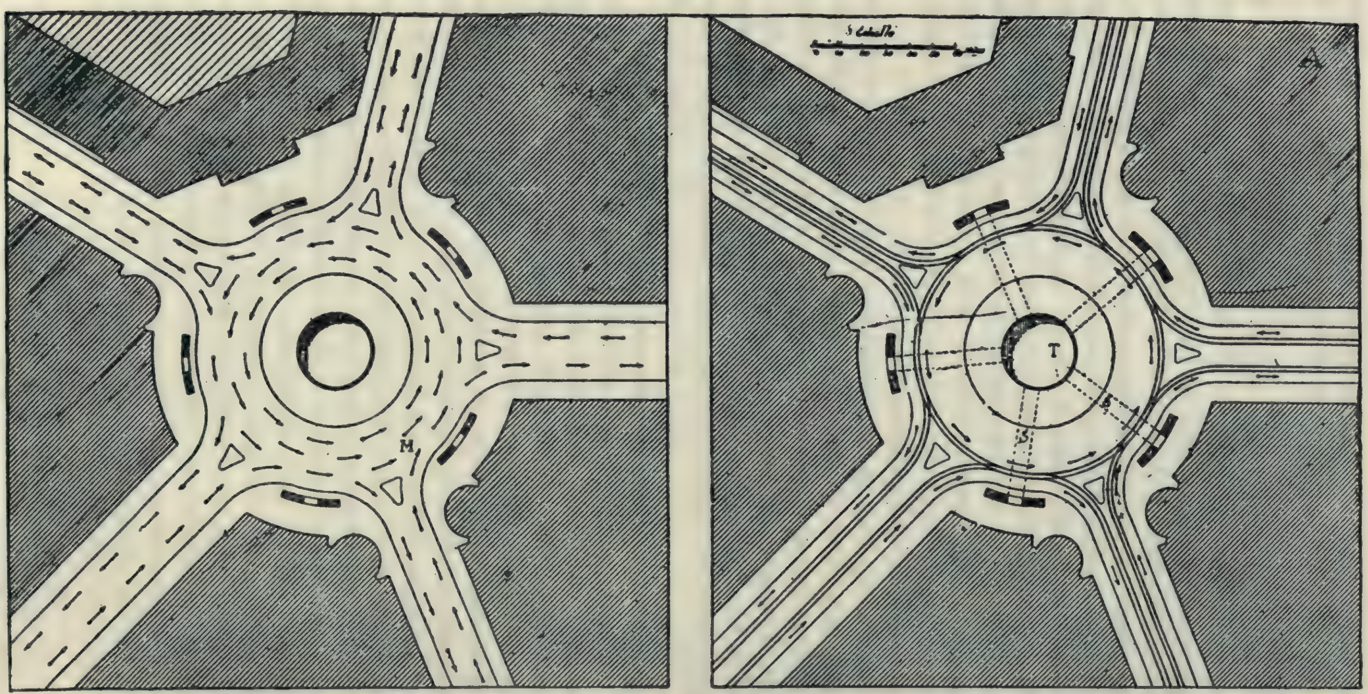


Fig 1 *Carrefour à Giration Disposition générale*

Fig 2. *Disposition des Lignes de Tramways*

Diagram A. Special Treatment of Traffic at a Multiple Street Junction by Circulatory Method

The fact that all of the buildings affected by the grade separation were nearing an obsolescent state made this improvement practical from the standpoint of damage to buildings. The real-estate values in the neighborhood of this improvement were in such a state of stagnation because of the congestion of traffic under the old conditions that the disruption of realty values was decidedly upward and was welcome.

An example of where the application of a grade separation has its disadvantages is the Roosevelt Road and State Street intersection in Chicago. The physical conditions made it necessary that Roosevelt Road be carried across State Street at a certain level which allowed three alternative solutions. State Street could either be carried up to the level of Roosevelt Road on approaches, it could be depressed slightly and carried under Roosevelt Road and side ramps could be constructed, or it could be carried under Roosevelt Road without any connection other than stairways. A careful study of the situation was made giving due weight to traffic considerations, to the economic features and to the finance of the improvement and the latter scheme was chosen. Because of the lack of direct connection between these two streets, and the inconvenience caused transferring street-car passengers, the real-estate holders of South State Street hold that this improvement has caused an undesirable disruption of values. A further study of the other alternatives only confirmed the decision that under present conditions the improvement, as it stands, is the best solution of the problem, but that the grade crossing of these two streets at the level of State Street would be the ideal solution. Both the creation of a grade intersection by bringing State Street to the level of Roosevelt Road by means of approaches and the creation of side ramps entailed such an expense and such a disruption of values and neighborhood conditions that they were impractical.

Another Chicago improvement which makes use of partial grade separation of traffic is the proposed South Water Street improvement. South Water Street is a natural and valuable artery for both heavy transfer traffic and light traffic. It is proposed to carry the heavy transfer traffic, which is slow-moving and causes the greater cross-traffic interference, on the lower level of the street, and the light fast-moving traffic on the upper level. This street crosses its cross streets right at the bridge heads and it is highly important that there be a minimum of traffic interference as the bridges are movable and there is a large volume of river traffic.

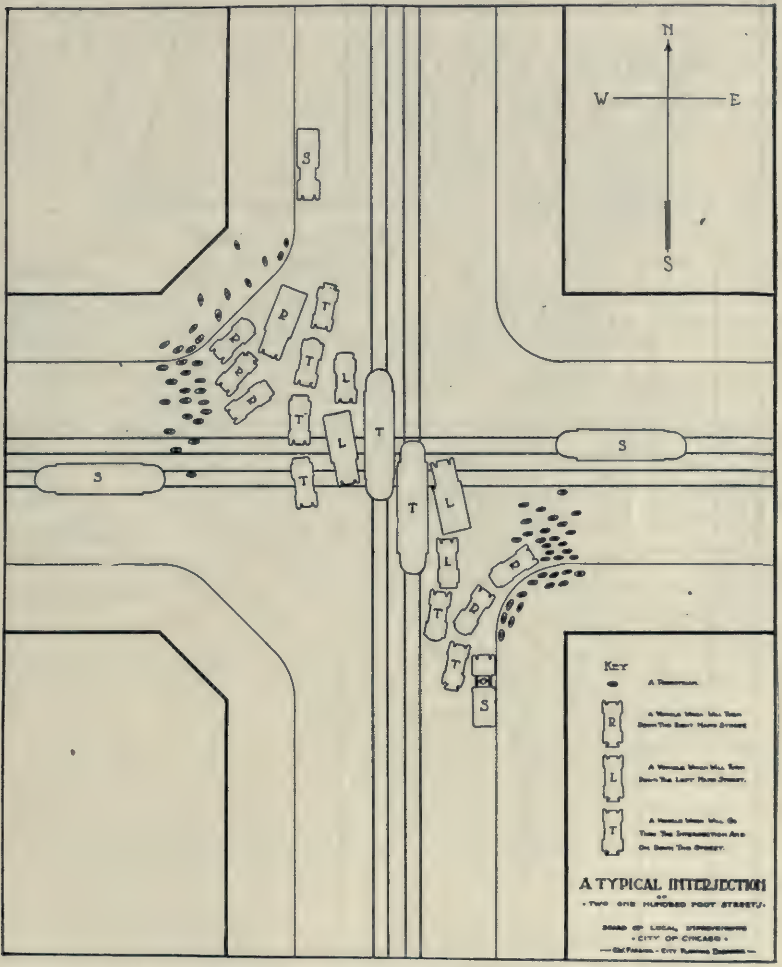
When it became necessary to consider the street-intersection problem in connection with the street widenings now under way in Chicago, the composite experience, study, and thought of a number of experts along these lines was brought to bear on this problem and the system evolved, it is hoped, will make a great improvement in the efficiency of important intersections where there is a great interchange of traffic from one of the streets to the other.

The principle of the system evolved is, briefly stated, the providing of storage spaces for that portion of the traffic which is changing its direction of movement, where it can await its opportunity to make its turn to the right or left without interfering with the thru traffic nor seriously interfering with the flow of pedestrians.

This system is simple in its application to almost every condition. It has no unnatural and revolutionary features to which traffic would have difficulty in accommodating itself. It involves very little additional damage to adjacent buildings and, as a project to be carried out under a special assessment, accommodates its expense of execution to the change of real-estate values in all parts of the city.

Figure 1, accompanying this paper, is a simple promotional sketch made to illustrate this system. The eastern side of the diagram depicts conditions with the usual condition found at simple street intersections. Any small volume of traffic changing its direction by turning to the right or left effectually blocks the thru traffic until it has an opportunity to make its turn. The right-turning traffic must force its way thru the flow of pedestrians, putting them in danger. The left-turning traffic has to await the passage of the flow of street cars before it can proceed and then must force its way thru the traffic stream flowing in the opposite direction.

On the western side of this diagram is shown the same intersection designed in such a way as to allow spaces for the storage of a certain amount of this turning traffic while it is awaiting its opportunity to proceed, and still be out of the way of the thru traffic lines. The right-turning traffic, if desirable, may here be prohibited from breaking thru the pedestrian line without any serious inconvenience to itself and without blocking the thru traffic behind it. When the whistle is blown for traffic to proceed on the other street this traffic can proceed on its way. The left-turning traffic can be provided with ample space to accumulate and wait for its opportunity to make its turn and proceed with a minimum delay to thru traffic in both directions.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Key
A Pedestrian.
A Vehicle Which Will Turn Down The Right Hand Street
A Vehicle Which Will Turn Down The Left Hand Street.
A Vehicle Which Will Go Thru The Intersection And On Down The Street.
A TYPICAL INTERSECTION
OF
TWO ONE HUNDRED FOOT STREETS.
BOARD OF LOCAL IMPROVEMENTS
CITY OF CHICAGO

DIAGRAM 1. TREATMENT OF TRAFFIC ON A TYPICAL RECTANGULAR INTERSECTION OF TWO 100-FOOT STREETS

Just how these results are to be accomplished, how far and in what way the corners of the intersections are to be cut back, varies as to method and degree with each case. So far no general rule has been evolved. Where this system is being put in effect in Chicago the design of the intersection was arrived at by lengthy

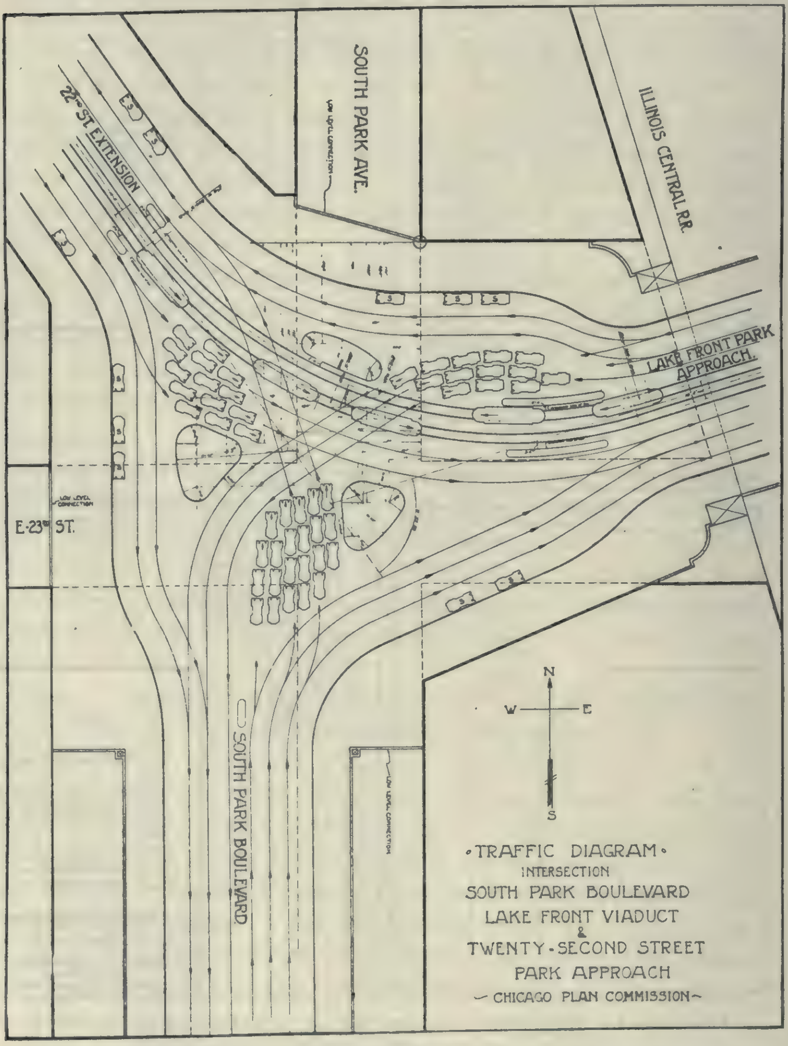


Diagram 2. Special Treatment of Traffic at Street, Avenue, Boulevard and Railroad-Crossing Subway

diagrammatic study both in plan and with the help of models, and by studying existing intersections where similar physical and traffic conditions existed.

Figure 2 is a plan of the intersection of Twenty-second Street extension, South Park Boulevard and a driveway to the new Lake Front Parks. The curbs of this intersection are on a constant three-percent grade from a city block north, west and south of this intersection to the western edge of the viaduct over the Illinois Central R. R. tracks east of the intersection, which adds a further traffic complication to this three-pronged intersection.

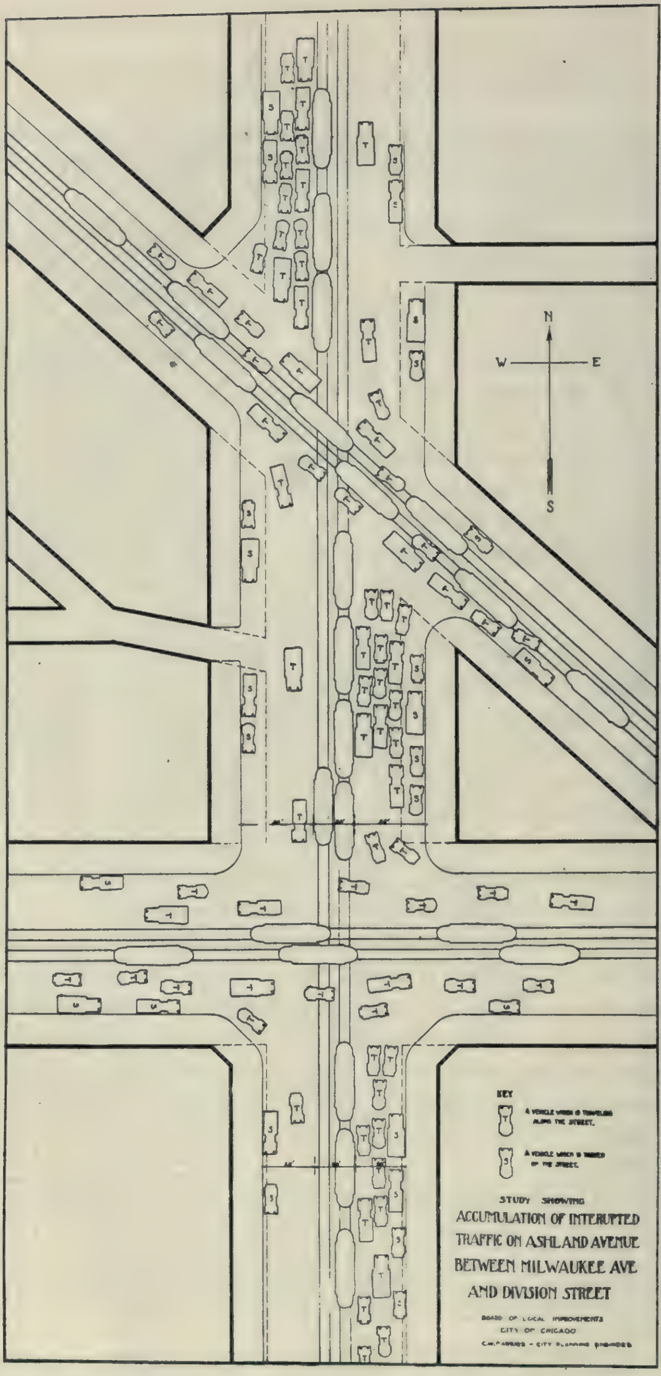
This intersection is destined to carry a large proportion of the rush-hour light traffic to and from Chicago's loop business district and the residential districts of the south side. It is highly probable that the traffic coming in on any of the prongs will split fairly evenly as to the volume of its bulk which will use the other two prongs.

To properly police this intersection it was held desirable, after study of similar existing traffic situations, that three traffic intervals should be allowed for in the design of the intersection. These three intervals will affect only the left-turning traffic. The right-turning traffic will flow at all times along the routes indicated in the diagram with no other interruption than the passage of pedestrian traffic. The flow of pedestrian traffic will at ordinary times be very small in volume. The left-turning traffic will turn into the reservoirs provided for it, shown on the diagram by the clusters of standing vehicles, and will there wait its proper traffic interval to flow on. The street cars will move during one interval.

This system of control is in general practiced along Michigan Avenue at the intersection of all of the streets dead-ending at Michigan Avenue without any storage spaces being provided. It proves successful enough to justify the belief that with the storage reservoirs for left-turning traffic provided this system will be highly efficient.

Figure 3 depicts this idea applied to a somewhat different problem. At the intersection of Milwaukee Avenue, Division Street and Ashland Avenue we have three important heavily traveled streets intersecting each other a very short distance away from each other.

One of the Chicago-Plan projects now in process of execution is the widening of one of these streets, Ashland Avenue, to a width of one hundred feet.



N
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KEY
A VEHICLE WHICH IS TRAVELING ALONG THE STREET.
A VEHICLE WHICH IS PARKED ON THE STREET.
STUDY SHOWING
ACCUMULATION OF INTERUPTED TRAFFIC ON ASHLAND AVENUE BETWEEN MILWAUKEE AVE AND DIVISION STREET
BOARD OF LOCAL IMPROVEMENTS
CITY OF CHICAGO

Diagram 3. Special Joint Treatment of Traffic at Contiguous Intersections of a Boulevard with a Rectangular and a Diagonal Street

An analysis of this particular intersection was made and it was found that if that portion of Ashland Avenue between Division Street and Milwaukee Avenue was made but one hundred feet in width it would be equivalent, in reducing the carrying capacity of the street, to the leaving of a portion of the street unwidened.

The distance is so short between the intersections of Ashland Avenue with these other two streets that during the time one of the cross streets is open to traffic and before the second one would be opened a condition of stagnation across the first street would be created by the backing up of the blocked traffic. The co-ordination of the control of these three intersections so as to keep both intersections of one street open for any considerable period of the traffic interval is, if not impossible, highly improbable. To remedy this situation as much as possible the street was made twenty feet wider at this point than the usual width of the street, to allow the traffic to close up into an additional line and so limit the possibility of creating a stagnation of traffic across the cross street which would delay the opening to traffic on the cross street.

This additional line of traffic will not entirely relieve the situation but it was not thought wise to create space for additional lines because of the difficulty of taking a new alinement when the surge forward takes place at the blowing of the policeman's whistle.

The limit to which this system of design is to be carried in each case depends upon traffic conditions, the value of the property affected, the damage to buildings in the case of the widening of an existing street, and the habits of the traffic and the pedestrians who frequent the intersection. In the case of the planning of a new project the limiting feature is the probable necessities of the case.

These squares, plazas, or open spaces have other value than being benefit to traffic. They create breaks in the monotony characteristic of streets which are a part of the gridiron plan of most of our American cities. That constitutes a worth-while aesthetic value. They, by breaking the monotony, call attention of the passers-by to the surrounding buildings and shops, which adds to the advertising value of the site and by so doing adds to the value of the property. Here is an aesthetic value which has a practical value.

When any one wants to poke fun at a piece of city planning he calls the opening up of important intersections on that plan architectural and questions its desirability. To prove his case he cites examples where such things are failures. Every one of the examples so far cited to us has upon investigation proved either faulty as to original design, as to the present design of roadways, or that it was designed with the traffic of thirty years ago in mind.

Traffic conditions have entirely changed in the last thirty years and the street arterial systems of our cities must be put in condition to meet that change. Commercial and industrial conditions have changed also in that period, but the systems which carry on the commerce and industry of our cities have to a great extent kept pace with this change. Universal paving of streets is about the only change that has been wrought in our arterial street systems. We are still plodding thru the mud of traffic congestion. An efficient circulatory system for traffic must be created in our cities if the cost of production in the cities is to be kept low enough so that the industries will not seek less centralized locations.

The aesthetic possibilities and their value must not be lost sight of in the creation of the circulatory system. The aesthetic features of one city of less commerical importance will attract visitors away from a city of greater commercial importance and of no aesthetic attractions. The city which has realized its aesthetic possibilities will advance commercially at the expense of its neighbor which has not.

In the execution of the Chicago Plan every effort has been made to make the projects efficient and worth while, and to realize all the aesthetic possibilities which could be put over. The Philistine attitude of the courts and the taxpayers is gradually being removed and we think the future is bright for the execution of the plan.

In order to put over the features which were used to illustrate this article they had to stand on their practical legs without aesthetic support. The courts and the public are open minded enough and pleased enough with other similar altho lesser accomplishments that so far the necessity for these special treatments has been maintained.

THE CONTROL OF THE LOCATION OF GARAGES BY ZONING

By Jefferson C. Grinnalds, Assistant Engineer, City Plan Commission, Baltimore, Md.

Regulation of garages with respect to their location has become one of the principal subjects to be treated by zoning ordinances. Indeed, garages and stores seem to be the "uses" which generally lead villages, small towns and medium sized cities to adopt zoning. Congestion in the downtown business district in lower Manhattan which led to the investigation of high buildings and subsequently to the zoning resolution for that city has not been the prime factor in driving other cities to zoning. Within the last three years perhaps about seventy cities have adopted zoning and it is probable that over three-fourths of them were prompted to resort to this regulation to control garages, public and private, and stores. Except for whatever protection special city ordinances have offered and whatever control was exercised by the building codes, the residential and first class commercial districts of all cities have been subject to invasion by these uses. Many times it was an unwarranted invasion. Probably 90 per cent of the cases of such invasions were for exploitation and the individual house owner was a victim of speculative greed. Few cases were prompted by pure necessity where it was necessary to have a garage or garages or a store to serve a particular neighborhood where there was a lack of those conveniences. If it could be shown that there was a lack of them, the conveniences would even become necessities. It is very seldom the case, tho, that there are inadequate store facilities, but in highclass residential sections there may be instances of the lack of automobile housing space within a reasonable walking distance or immediately adjacent to a large apartment house. In the latter case a garage on the premises is almost a necessity and it is possible that the courts may take that view.

Building Codes

Under building codes it has been the practice to define what is a private garage and what is a public garage. It is usually done by specifying that a garage or group of garages for more than a certain number of vehicles shall not be deemed a private garage. The number of vehicles varies in different cities, sometimes it may be two or three or four or five. It seems that the number of vehicles may properly be limited and the definitions of public and private garages are proper subjects for regulation under the police power. Some cities include in their building codes regulations which require that permits may not be issued for the erection of public garages without the approval of the Mayor or some board or commission. There is one city in particular which has by ordinance, which is made part of the building code, placed public garages in a restricted class along with certain nuisance industries and other "uses" which are subject to the approval of the mayor before a permit may be issued by the building inspector. This ordinance has been upheld by the highest court in that state in the case of Osborn vs. Grauel, 136 Md. 88. The characteristic of building code control over garages is that all parts of the city are treated alike. This control can be varied somewhat to fit the particular type of development in cases where approval of the mayor is necessary, but usually there is no discrimination as far as the ordinance is concerned between natural residential, commercial and industrial districts of the city. The same law is applicable to any kind of a district.

Special Ordinances

Special ordinances relating to the location of garages are passed from time to time and are in existence in many cities. One of the most common regulations of this kind is the prohibition of a public garage within a certain radius of a church or educational institution. Control by this method is good in some cases and works hardship in others. In residential districts, the character of which has already been established and where invasion by a public garage would depreciate property values, increase the fire hazard, be dangerous to children going to and from school by reason of the number of vehicles or the speed with which they move, or giving out unseemly noises and odors near places of worship, this method of control is probably good. One can conceive however of an instance where an old church in the downtown section of a city has been almost completely surrounded by business of a type varying from quiet, unobtrusive retail shops selling delicate fabrics or millinery to certain types of industrial manufacture, even manufacture of the nuisance type. In such a neighborhood the location of a garage would probably not depreciate the value of property, even it it were within the minimum distance within which it could approach a place of worship. It is probable that the very old churches in the downtown districts of cities will pass and congregations thereof will seek new locations nearer to their places of residence and away from the congested districts. This is the tendency in every city with regard to churches. Some very few outstanding examples to the contrary do exist but they are now the exception rather than the rule and it seems proper that a law should be drawn for the protection of the many against the few, that is for the general welfare and not for the protection of special cases. Here is where the building code regulation is again inadequate, because it does not discriminate between the kind of districts where the schools or churches are situated. What was once a residence section in a city may change, in the absence of zoning, to a business district and so the law would not be reasonable.

Regulation of Garages by Zoning

Zoning divides a city into districts where the uses of the property in the different districts are regulated, where residence districts are protected against business and industrial encroachments, where retail shopping districts are protected against nuisance industry. The characteristic feature of zoning is that similar districts are treated by similar regulations and different districts are subject to different regulations. The extent of control that ought to be given to regulate garages in residence districts need not be carried so far in the business districts and it is probable in industrial and nuisance districts no control as to the location of garages is necessary or ought to be exercised. This is the point where zoning endeavors to give protection where it is necessary but not to unduly restrict business where it is unnecessary.

Accessory Uses

Zoning ordinances usually permit private garages as accessory uses in residential districts, and the ordinance usually defines what shall be an accessory use or how many motor vehicles may be permitted in a private garage. Private garages are presumed to be necessities in those districts and zoning takes the stand that they are accessory to the primary use of the building or land which is residential. A sample zoning regulation is as follows: "A garage or group of garages for more than five motor vehicles shall not be permitted as an accessory use" (In a residential district in Newark, N. J.). Another phrase sometimes used is "the term accessory use shall not include a garage other than a private garage" (from the zoning ordinance of Brockton, Mass.) These are typical regulations relating to garages as accessory uses in residential districts. The zoning ordinance of Milwaukee permits the storage of one commercial vehicle in an accessory garage. Occasionally it is specified that an accessory garage need not be occupied by motor vehicles owned by the occupant of the premises. A variation of this is that space for not more than one or two commercial vehicles may be leased or that the lease may be subject to the board of zoning appeals. In the large-volume residence districts of East Orange the following is the law: "space for not more than one commercial motor vehicle for each one thousand square feet in excess of five thousand square feet of the lot area may be leased, provided that space for two non-commercial vehicles may be leased in any case." In residence district, Class 2, Atlanta, Ga., and Lakewood, Ohio, the stipulation is as follows: "A private garage permitted as an accessory use shall not provide storage for more than one motor vehicle for each one thousand square feet of the lot area." This requirement of lot area is a distinct departure from building code regulations. It is intended to prevent garages of an undue size being built on the same lot with a dwelling and ought to tend to produce larger building lots. Similar to the building code regulation, it is common to find that garages are subject to certain prohibitions with reference to churches, schools, et cetera; for example the zoning ordinance of East Orange, N. J. says: "(in residential districts) except as herein before provided no public or private garage for more than five motor vehicles shall have an entrance or exit for motor vehicles within 200 feet of the entrance or exit of a public or private school playground, public library, church, hospital, orphanage or children's home for children under sixteen years of age. The law in New York City is similar except that it applies to schools, hospitals, or charitable institutions within a distance of 200 feet of the proposed garage.

Garages under a Board of Zoning Appeals

To prevent undue hardship or what might seem to be confiscation of property, zoning ordinances usually provide for a board of zoning appeals or a city plan commission or some other board with power similar to that granted the board of appeals in New York City. From the New York ordinance: "The board of appeals, created by Chapter 503, of the laws of 1916, may, in appropriate cases after public notice and hearing—and subject to appropriate conditions and safeguards, determine and vary the application of the use district regulations herein established in harmony with their general purpose and intent as follows: Permit in a business or residence district the erection of a garage provided the petitioner files the consents duly acknowledged of the owners of 80 per cent of the frontage deemed by the board to be immediately affected by the proposed garage. Such permit shall specify the maximum size or capacity of the garage and shall impose appropriate conditions and safeguards upon the construction and use of the garage." Such power given to a board of appeals seems necessary. The board is a safety valve, so to speak, to relieve the pressure which may arise where, under appropriate safeguards, it would not be detrimental to certain residence uses to have in their midst or nearby a garage. A case might arise where a garage is necessary in a residential neighborhood to supply the needs of the community. Apartment houses might be built in a "U" or open square and it might be necessary to serve a building of large bulk with a garage that ought to be located on the same lot. In the latter case it may be that there is no available site in the immedate vicinity and under proper conditions a board of appeals might permit a garage in what is described by the zoning ordinance as a residential district. Some zoning ordinances go farther and permit the location of any use in any district subject to approval of the board of zoning appeals after notice and public hearing.

Garages Outside the Residential Districts

Some zoning ordinances prohibit public garages in retail business districts and from zones which are set aside for light industries. This prohibition would probably be applicable or inapplicable according to the city. It may depend on the size of the town or city or it may vary with the kind of municipality, whether it is a residential community or whether it is a manufacturing center. It is conceivable that in a municipality like Brookline, Mass. which is practically a residential development, garages in the local business center would properly be subject to different regulations from the regulations necessary for garages in the loop district in Chicago. On principle it seems as tho it would work a hardship to exclude garages generally from commercial zones. This suggests the reasonable alternative to the building code regulation, which prohibits public garages within a certain radius of churches thruout the city, that is, that where a zoning ordinance carried with it a specification prohibiting garages within so many feet of a church, the board of zoning appeals ought to be given the power to vary such a regulation which would involve undue hardship and probably needless discrimination. In the heavy industrial zones and zones where nuisances must be segregated garages are permitted unqualifiedly.

Zoning Versus Building Code Regulation

This is to emphasize once more that whereas building codes are usually operative thruout the city without any reference to the character of the existing uses or to the probable future uses of an open undeveloped area, zoning ordinances treat different kinds of districts with different regulations provided that similar districts are subject to similar regulations. This is to emphasize further that the control of the location of garages ought to be by zoning ordinance.

ATHLETIC FIELDS AND STADIUMS

Classification by Games

By Arthur Leland, Supervisor of Recreation, Newport, R. I.

Base-Ball Diamonds

Base-ball diamonds should be so oriented that the sun shines in the fewest number of player's eyes. If the sun must shine in anybody's eyes make it shine in the first baseman's and the right fielder's in preference to the other side of the diamond.

Base-ball diamonds for boys under fifteen years should be two-thirds regulation size. It is impossible to maintain grass on the diamond which is in continuous use. The pitcher's box should be the highest point in the diamond and the outfield the lowest point.

Drainage should be provided outside of the foul lines for the infield and beyond the usual playing area, if possible, for the outfield. Grass may be maintained in the outfield of the baseball diamond even if the field is to be used continuously, by proper preparation of the soil and selection of proper seed.

Area Required. According to the rules a baseball field should have 90 ft. from the back stop to home plate. A good batter can bat a ball over 300 ft. but a radius in front of home plate of 235 ft. will not injure the game. The use of screens and hood back-stops greatly decreases the destructive area of the baseball and makes it possible to play the game on a very small piece of land within the city limits. In Newport, Rhode Island, a very successful amateur base-ball league is conducted on a field 2.4 acres in extent. Where the rules call for the back-stop the railroad station is located; between that and home plate intervenes a street where taxi cabs are parked, then there is a hand-ball court, then the back-stop which is 12 ft. back of home plate. The greatest width of the field is 250 ft. It is only 210 ft. from home plate to right-field fence. If left-field fence was as near, the playing area would be less than 1/2 acre. The extreme width of the field is 400 ft. There are bleachers with a seating capacity

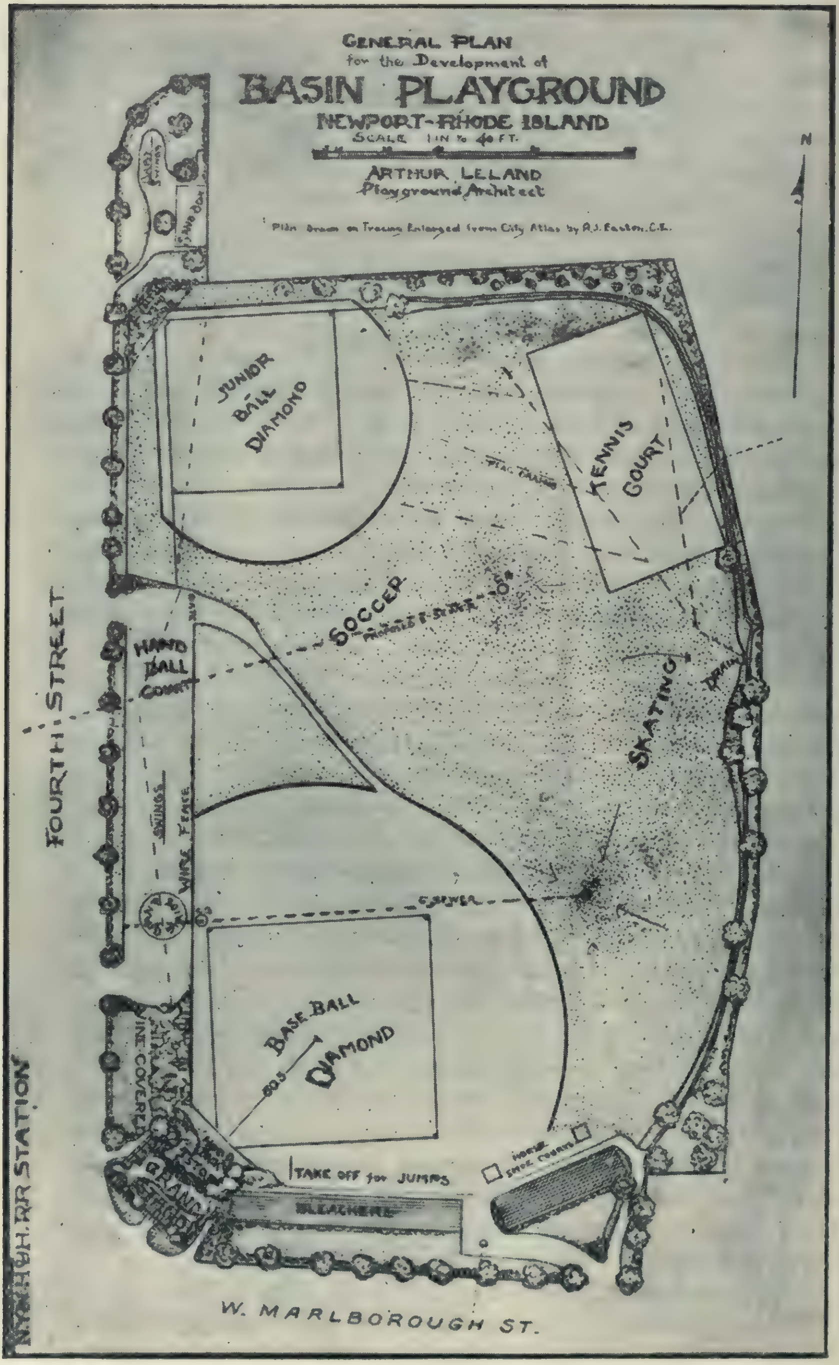


Fig. 1. Basin Playground at Newport, Rhode Island

of a thousand. It is planned to put more bleachers in to double the seating capacity. As many as 2500 people now see the games. There is a play ground for little children with swings, see-saws, giant stride and sand box. There are a lawn, hedges, and shrubbery, space is reserved for a tennis court and there is also a junior diamond at the other end of the field, there are horse shoe pitching courts, a refreshment booth. The hat is passed and the proposition is self-supporting and this year is paying 10 percent on the investment for retiring the cost of construction.

Play-Ground Ball

Play-ground ball is coming to be an important competitor of baseball as it can be played by all ages, requires no expensive equipment of gloves, masks, and gear, and provision should be made for this in each play field.

The play-ground ball diamond is 20 ft. beyond the bases, and 5 ft. outside of the foul lines with 5 or 6 ft. to the back stop gives sufficient space for playing this game. As the ball used is soft no damage occurs if it encroaches on other parts of the playground.

Coasting

Coasting is such valuable exercise that provision should be made for it even if nature does not supply the required hills. Nature can be helped sometimes.

Field Hockey

Field or lawn hockey is coming to be one of the most important games for women, being played very extensively at the girl's colleges. It requires about the same size field as a foot-ball field and it will be possible to devise an attachment to put on the regular foot-ball goal so that the same field could be used for both games.

Lacrosse

In the northern section of the country adjacent to Canada, lacrosse is played quite extensively and provision should be made for this game. It requires a field 150 to 225 by 330 to 375, preferably covered with turf. The standard foot-ball field will do very well for lacrosse.

Foot Ball and Soccer Fields

College foot-ball requires a field of 60 by 360. The field can be used for soccer and the games can be played on the field interchangeably, by making a combination goal; the under part being 24 ft. wide and 8 ft. high for soccer and the upper part to contain the uprights and crossbar for the college foot-ball game.

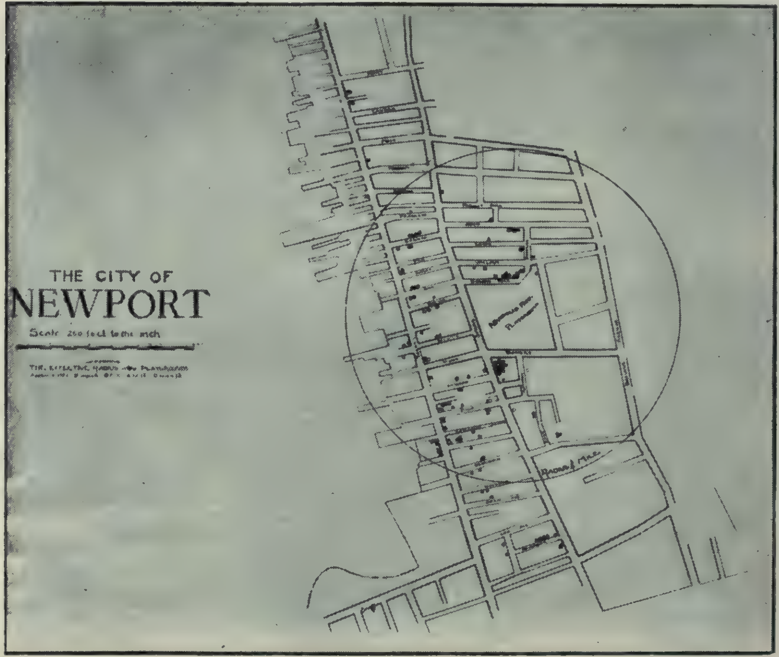


FIG. 2. ACCESSIBILITY OF RECREATION FACILITIES AT NEWPORT, RHODE ISLAND

Tennis

Tennis takes properly an area 60 ft. by 120 ft. for each double court, the minimum area being about 48 by 108.

Lawn Bowls

Lawn bowls take an area 19 to 21 ft. by 120 ft. for each rink.

Golf Links

Golf links require from 60 to 150 acres and upwards according to the lay of the land.

Horse-Shoe Pitching

A horse-shoe pitching court requires an area of 6 ft. by 46 ft. net.

REPORT OF COMMITTEE ON STREET LIGHTING

It is the purpose of the Committee in preparing this report to outline the trend of developments in the art of street illumination during the past year with special reference to notable departures in equipment and practice.

A new 2500-candle-power (25,000-lumen) gas-filled incandescent lamp of the 20-ampere series type has been developed and placed on the market. This new lamp is the most powerful light source which has ever been made available commercially for the lighting of streets. It is particularly adapted to business street lighting in those cities where it is desired to use especially high levels of lighting in important, congested districts. Previously the strongest illuminant available in the series-type gas-filled tungsten lamp was one of 1500-candle-power (15,000-lumen). The 2500-candle-power lamp makes it possible, therefore, to obtain nearly twice as much light from a single incandescent light source as could be obtained heretofore.

The old style less efficient arcs have practically disappeared from use. They have been replaced in most cases by gas-filled incandescent tungsten series lamps. Incandescent lamps are now available in a complete range of sizes up to 2500-candle-power, interchangeable on the same circuits and adapted for use in a wide variety of lanterns, globes, and refractors, for white-way, thorofare, boulevard, residence-street, and highway lighting.

There is a very noticeable trend toward the use of larger lamp sizes. Engineers who have studied comparative costs and efficiencies are in agreement that 100-candle-power is the minimum illuminating lamp size which it is economical to use for street lighting. The lamps of less than 100-candle-power which are in use under the terms of some of the older street-lighting contracts not only operate at a lower efficiency, but are uneconomical because too great a proportion of the annual street-lighting cost to the city (sometimes as much as three-fourths of the total expenditure) is made up of fixed charges on the installation, and only a relatively small part of the expenditure goes for the production of light. Particularly where ornamental equipment is installed and where the investment cost is therefore fairly high per lamp, there is a growing conviction that the 250-candle-power lamp is the minimum economical size to be used in designing a new installation. However, very effective systems using lower candle-power lamps are being installed.

As pointed out in previous reports, ornamental lighting equipment is rapidly becoming the standard, not only for business districts and parks, but also for thorofares and residential streets thruout the area of the city. While, of course, in many cities the overhead wooden-pole mast-arm or the center suspension is still being retained, this type of construction is coming to be regarded somewhat as a temporary or emergency measure which serves until arrangements can be made for suitable ornamental lighting.

It is noted that a very large number of new real-estate subdivisions are being lighted by ornamental standards properly spaced before the lots are placed on sale. This is unquestionably a desirable practice, for not only are the property values increased by the absence of unsightly wooden-pole constructions on the streets, but it is also true that the underground-circuit construction, erection of posts, etc., can usually be handled much more economically before the streets have been paved, and before concrete drives have been put in, than afterwards.

One reason for the growing popularity of ornamental equipments for thorofare and residence streets has been the development of such units, which retain the efficiency characteristic of well designed overhead pendent utilitarian units. Thus in addition to the familiar opal globe, there are now available a number of carefully worked out refracting and reflecting units, varied in contour and appearance, suitable for both upright and bracket mounting, which give a materially increased utilization of light on the street surface.

There have been many important extensions and improvements in the lighting of different cities during the past year, too many, in fact, to be individually discussed. However, among these a notable installation utilizing a new equipment combining efficiency and good appearance is that in East Cleveland, Ohio, wherein a refractor lantern with a ripple enclosing globe is mounted on a 4½-foot bracket 16 feet above the street for the residential districts. On the thorofares 400 to 1000-candle-power lamps in

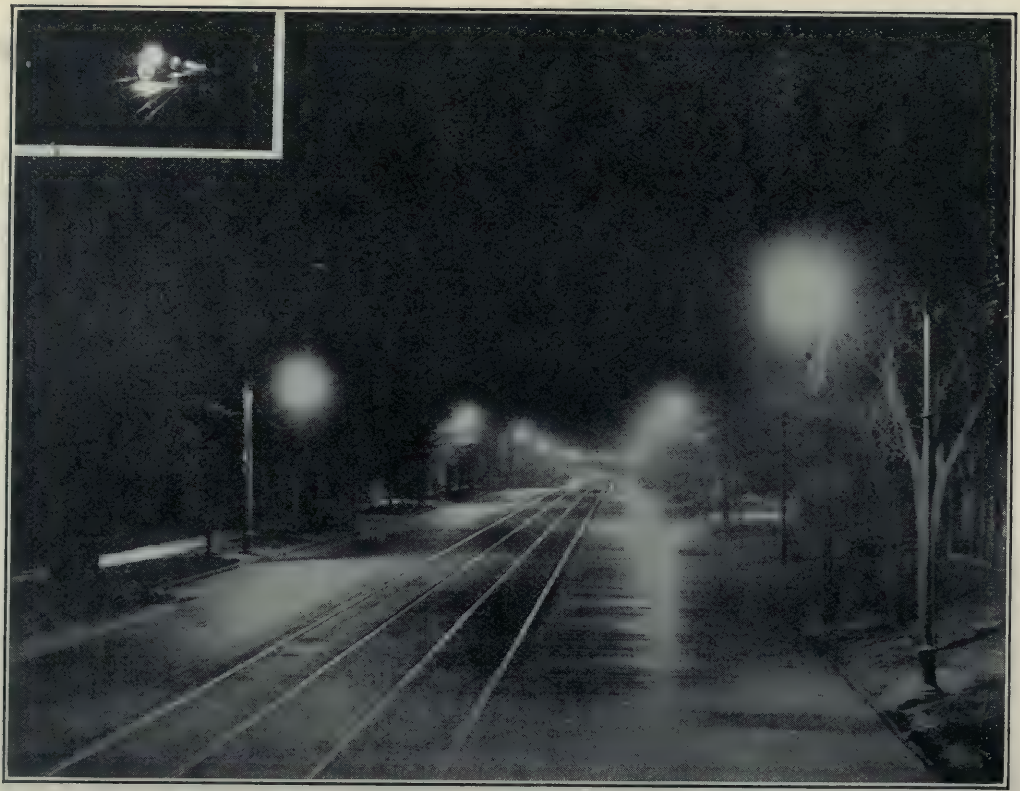


FIG. A. THOROFARE LIGHTING IN EAST CLEVELAND, OHIO

1000-candle-power gas-filled lamps are used, equipped with pendent refractor lanterns. Arrangement-staggered, one unit every 140 feet of street; mounting height, 20 feet; bracket length; 6 feet.

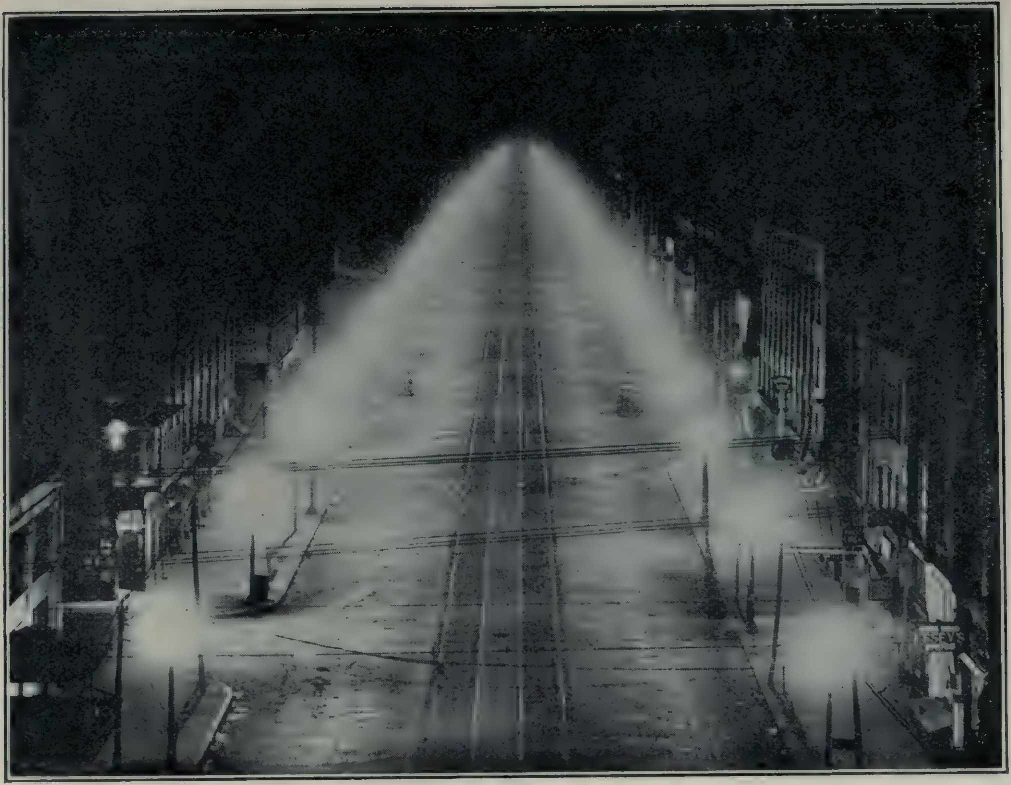


FIG. B ORNAMENTAL STREET LIGHTING IN A SECONDARY BUSINESS DISTRICT OF CLEVELAND, OHIO

In this city 1500-candle-power and 1000-candle-power gas-filled lamps are employed, equipped with upright refractor lantern fixtures mounted at a height of 15 feet and spaced 85 feet apart.

similar units of larger size are used with a mounting height of 20 feet and a bracket 6 feet in length. A novel feature of this installation is the use of 150-watt multiple lamps (200-c.p.) in the residence districts supplied from underground circuits brought out along the side lot lines. By this means the lamps are furnished with current from the regular 115-volt house-lighting circuits without separate distribution. They are turned on and off by automatic switches located in each block.

The entire city of Kansas City, Mo., is being relighted by ornamental units containing 400 and 600-candle-power mazda lamps in rippled diffusing globes. The installation is expected to total 10,000 units or more. Ornamental trolley-pole brackets are used in the main business section. Ornamental posts evenly spaced are installed for all other streets.

In St. Paul, Minn., Summit Avenue, a well kept residential boulevard, was lighted by a new system consisting of 400 ornamental refractor lantern standards with 400-candle-power incandescent lamps spaced approximately 120 feet apart.

Mandan, North Dakota, a city of 4,336 people, installed a new ornamental system of 447 standards, one lamp standard for every ten persons.

There has been growing interest in the subject of lighting of highways between cities during the past year, stimulated by a desire to increase the safety of night driving on these thorofares. One special equipment which has been developed for this purpose consists of a double set of parabolic reflectors which confine the light to the roadway. Favorable comments have been made upon a number of installations of these units mounted from 30 to 35 ft. above the road and spaced from 300 to 500 ft. apart. One result of the development of artificial lighting of highways will undoubtedly be a further increase in night traffic passing thru cities and villages, which in turn will require an increased provision for proper illumination of the thorofares leading thru the municipalities.

Among the data on the relation of better lighting to accident and crime prevention which have been brought forward in the past year may be mentioned a survey discussed in a paper presented before the Society last November showing that 17.6 percent of the street traffic accidents occurring at night were attributable to lack of illumination. According to this survey nearly 600 fatalities are annually chargeable to this cause, and approximately $54,000,000 of the annual street accident loss. At the same time it was reported that the total expenditure for street lighting in the United States was not in excess of $50,000,000. It was further pointed out that the figure of 17.6 percent was very conservative in evaluating the usefulness of illumination in preventing accidents for, as a matter of fact, the streets of all of the cities covered in the survey were illuminated at night by lighting of varying degrees of effectiveness. According to the survey referred to, in an individual city where the need for better street lighting is especially evident the percentage of night accidents chargeable to the lack of light is likely to run as high as 50 percent. On the other hand, in the case of those districts where fairly high levels of artificial street lighting are provided by so called white-way systems, the percentage of night accidents chargeable to lack of illumination can be said to be fairly low.

It is pertinent to emphasize that while the expenditures for higher levels of artificial street illumination may be amply justified as an accident-prevention measure, they can also easily be justified when the effect on the reduction of crime is taken into consideration. For example, a recent analysis of crimes occurring in the down-town district of Cleveland indicated that the installation of the white-way lighting system could be credited with a decrease of 41 percent in the amount of crime on those particular streets as compared with the remainder of the city.

In the past there has been a wide diversity in practice as to the illumination of streets of the same character and importance in different municipalities. These variations have been due in part to differences in local opinion as to the requirements to be fulfilled, but in many cases the extent of available funds has been the important governing factor. With more evidence as to the real value of street lighting, not only from the standpoint of comfort, convenience, and commercial advantage, but also from the standpoint of accident and crime prevention, there appears to be a more definite crystallization of opinion as to the desirable practice for the different classes of streets. The following table has been assembled to indicate the desirable range of practice under present conditions.

Street Lighting Practice

STREET CLASS	LAMP-C.P. PER POST	MOUNTING HEIGHT	DESIRABLE LAMP SPACING, FEET	ARRANGEMENT OF LAMPS	LAMP-C.P. PER FOOT LENGTH OF STREET
100,000 Population or Larger					
Principal business	1000–5000	14–25	80–150	Parallel	20–100
Secondary business	1000–2500	14–18	80–125	Parallel	10–50
Principal thorofares	600–1500	20–25	125–250	Parallel or Staggered	3–10
Secondary thorofares, wholesale and mfg. district	400–1000	20–25	125–250	Staggered	2–5
Boulevards and parks	250–1000	14–20	125–250	Parallel or one side	1–5
Residential	250–600	14–20	125–250	Staggered	1–4
Alleys business section	250–600	16–20	125–250	One side	2–5
Outlying streets and alleys	100–250	16–20	200–400	One side	$\frac{1}{4}$–1
20,000 to 100,000 Population					
Business	1000–2500	14–18	80–125	Parallel	10–50
Thorofares	400–1000	20–25	125–250	Staggered	2–5
Boulevards and parks	250–1000	14–20	125–250	Parallel or one side	1–5
Residential	250–600	14–20	125–250	Staggered	1–3
Outlying streets and alleys	100–250	15–20	200–400	One side	$\frac{1}{4}$–1
5000 to 20,000 Population					
Business	600–1500	14–18	80–125	Parallel	5–30
Thorofares	400–1000	20–25	125–250	Staggered or one side	2–5
Boulevards and parks	250–600	14–20	125–250	Parallel or one side	1–3
Residential	250–400	14–20	125–250	Staggered or one side	1–3
Outlying streets and alleys	100–250	16–20	200–400	One side	$\frac{1}{4}$–1
5000 Population or Smaller					
Business	250–600	12–16	80–125	Parallel or staggered	2–10
Thorofares	250–600	16–20	125–250	Staggered or one side	1–3
Residential	250	14–20	125–250	Staggered or one side	1–2
Alleys	100	16–20	200–400	One side	$\frac{1}{4}$–$\frac{1}{2}$
Highways	250–400	25–35	300–600	One side	$\frac{1}{2}$–1

The committee recognizes that the 100-c.p. lamps have a place in residential sections, on narrow streets, curbed parkways, in parks, in alleys and certain outlying streets.

CHARACTER OF CONSTRUCTION

Varying types of ornamental equipment are suited for the different classes of streets. For business streets the upright column with a single lamp is most common, tho ornamental trolley-pole brackets are often used. For intensive or white-way lighting with 3000 to 5000-candle-power per standard, 2-light or 3-light units have been adopted. For thorofares, boulevards, parks, and residential streets, both ornamental bracket standards and upright standards are common. In some instances ornamental brackets are attached to trolley poles or to other poles already in place. The preference is for underground wiring, tho some ornamental poles can be successfully adapted to use overhead wiring. For outlying districts, alleys, and highways, underground wiring is seldom practical.

The cost of street lighting per lamp-post has not shown the same ratio of increase as other municipal safety services, such as fire and police protection. As a matter of fact, the present average annual expenditure per capita for street lighting is less than $1.00. This low figure, however, results from the circumstance that a great many municipalities have not revised their street-lighting systems to make them adequate under the new and more severe requirements imposed by the greater traffic hazards introduced by the universal adoption of automobile transportation. In many municipalities there is still barely one lamp for each street intersection. Such lighting was considered quite satisfactory 10 or 15 years ago, in the days of horse-drawn traffic, but now it is inadequate and unsatisfactory from the standpoint of sufficient illumination, and present-day conception of proper street appearance.

The experience of a number of municipalities that have improved their lighting thruout the city to bring it in line with modern standards indicates that this can be done effectively at the modest cost of from $1.50 to $2.50 annually per capita. In most cases the latter figure makes possible the installation of an ornamental system thruout the city. In a comprehensive survey recently reported, the highest expenditure of any city was $4.81 per capita per year. It should be pointed out, however, that comparisons of cost on a per-capita basis are likely to be misleading, since there are such great variations in miles of paved street per thousand of population. Street length as a basis of computation introduces other variables depending upon the arrangements of intersections, width of streets, amount of foliage, character of paving and local costs, but the following tabulation is given as indicating the range of cost of carefully designed ornamental street lighting for different classes of streets, assuming that there are no extreme conditions affecting the cost.

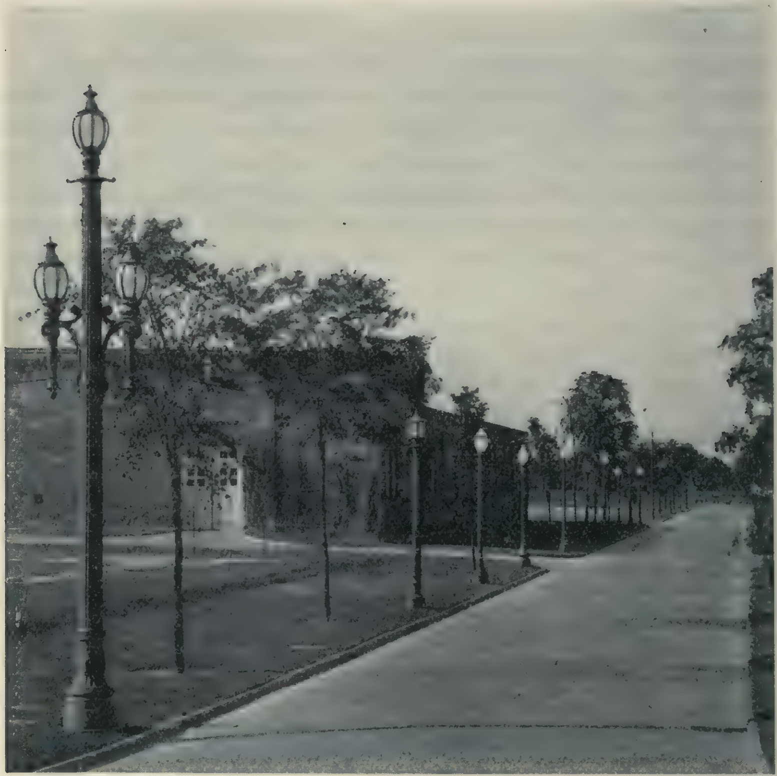
	ANNUAL COST PER FOOT LENGTH OF STREET	
Business-district white-way	$1.00	$4.00
Thorofares and boulevards	0.30	1.20
Residential streets	0.20	0.80

The crowded condition of city budgets has made it difficult for many municipalities to provide the necessary improvements in street lighting. In recognition of this difficulty some states already have acts permitting improved street lighting to be charged back to property holders as is done in the case of paving and other necessary street improvements. Under this plan the contract for the installation and operation of the lighting can still be handled by the municipality itself, and this is very desirable to insure continuance of good service.

For years it was almost the universal practice to have the contract charges for street lighting based on a fixed charge per lamp per year, which included allowance for carrying charges on the investment as well as the cost of operation and maintenance. However, in the case of white-way lighting, on account of the special investment necessary, the equipment has often been installed by the municipality and a separate contract entered into for the operation and maintenance of the system. This same practice appears to be growing in favor in the case of municipalities where ornamental installations are being made for the entire city. Proponents of this plan point out that the municipality, under this arrangement, has an unlimited choice in the selection of the type and design of standards and lamp equipments installed, and at the same time is in a position to secure favorable rates for maintenance and operation of the system since the contractor is not faced with the necessity of amortizing the investment during a relatively short contract period.

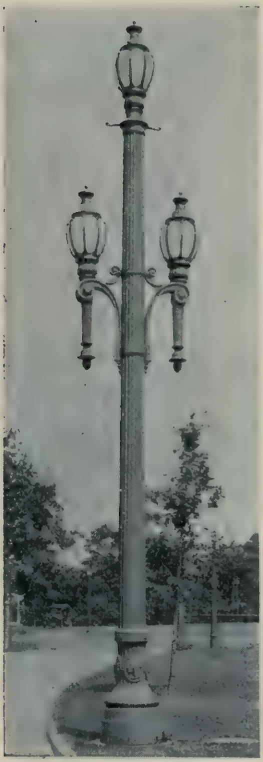
Your committee wishes to direct the members' attention to the exhibition of ornamental street-lighting equipment which has been arranged at Nela Park thru the courtesy of the Engineering Department, National Lamp Works of General Electric Company and different manufacturers of lighting equipments. In the exhibition are included representative lamp standards and modern lighting units of the various types now available for the illumination of business streets, thorofares, boulevards, parks and residential streets. Photographs of this comprehensive exhibition, supplement this report.

C. W. Koiner, *Chairman*,
Earl A. Anderson,
Ralph Toensfeldt.



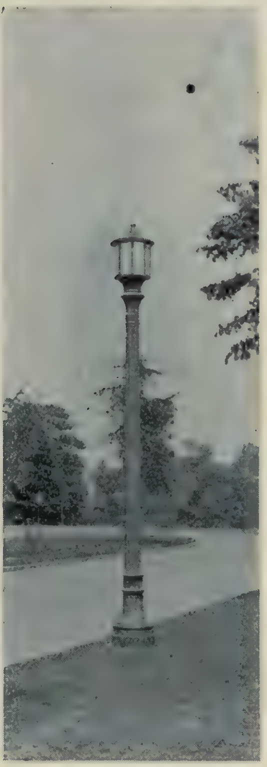
Exhibition of Ornamental Street Lighting Equipment, Nela Park

Supplement to the 1922 report of the Committee on Street Lighting, American Society for Municipal Improvements. One of the valuable features of the exhibition is that it affords an intimate comparison of the most up-to-date equipments which are available at the present time. Definite ideas can be obtained of the day and night appearance of the units. Each unit can be turned on and off individually so that its appearance when lighted, as well as its particular characteristics of light diffusion and light distribution, may be observed without interference from adjoining units.



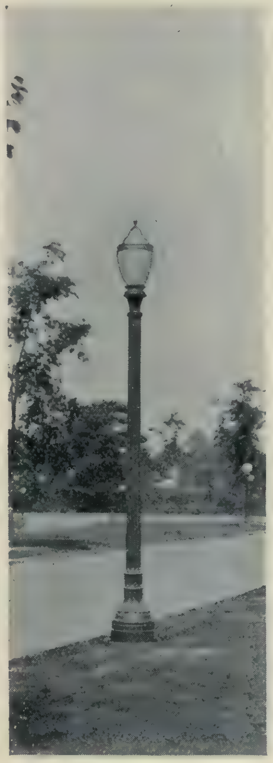
No. 1

Form 9 Novalux unit with 8-panel clear stippled glass globe and dome refractor, made by General Electric Co.—Pressed steel standard, Design No. 1161, made by The Union Metal Mfg. Co.—1500 c.p. (15,000 lumen) Mazda C lamps—Height to light source 19 ft. to 25 ft.



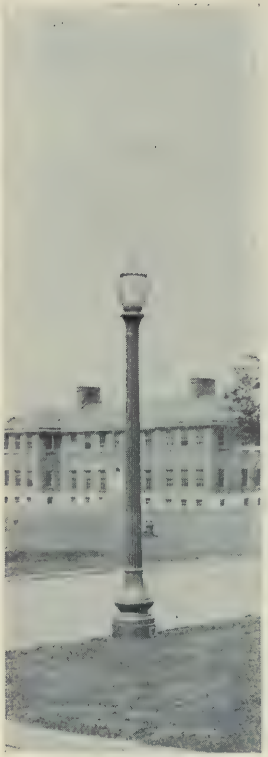
No. 2

Colonial Reflecto-Lux lantern unit with clear ribbed glass panels, parabolic reflectors, and cast-iron standard, Design Broadway, made by Geo. Cutter Works of Westinghouse Electric & Mfg. Co.—1500 c.p. (15,000 lumen) Mazda C lamp—Height to light source 14 ft.



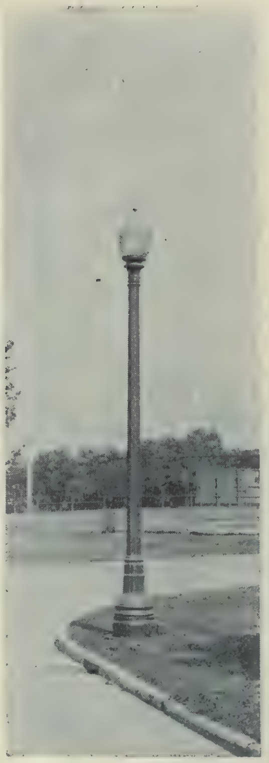
No. 3

Form 12 Novalux unit with polycase glass globe and canopy, made by General Electric Co.—Cast-iron standard, Design No. 13 made by King Mfg. Co.—1500 c.p. (15,000 lumen) Mazda C lamp—Height to light source 14 ft.



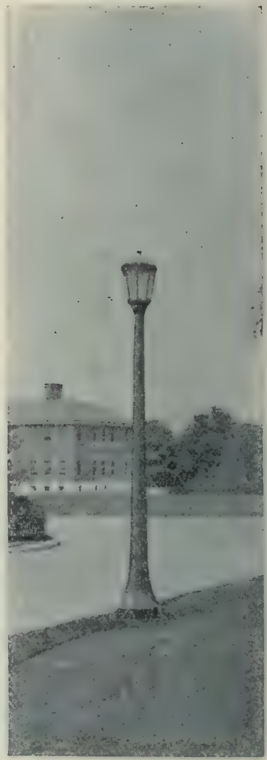
No. 4

Sol-Lux unit with Monax glass globe and canopy, holding band, and cast-iron standard, Design Continental, made by Geo. Cutter Works of Westinghouse Electric & Mfg. Co.—1500 c.p. (15,000 lumen) Mazda C lamp—Height to light source 13½ ft.



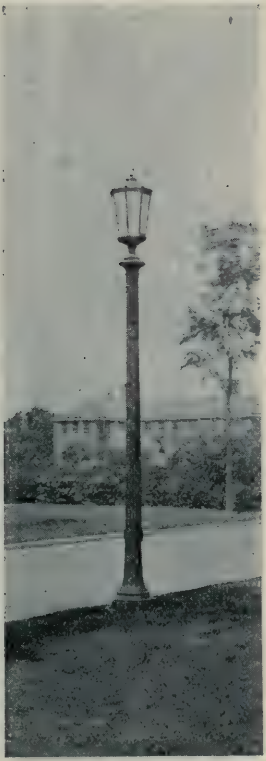
No. 5

Form 16 Novalux unit with light alabaster rippled glass globe and canopy and dome refractor, made by General Electric Co.—Cast-iron standard, Design No. 45, made by King Mfg. Co.—1500 c.p. (15,000 lumen) Mazda C lamp—Height to light source 15 ft.



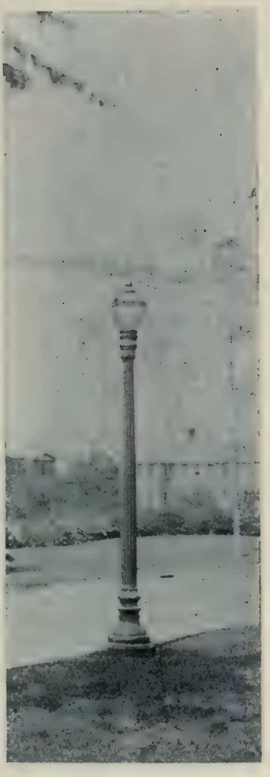
No. 6

Octagonal Reflecto-Lux lantern unit with clear ribbed glass panels, parabolic reflectors, and cast-iron standard, Design Arcadian, made by Geo. Cutter Works of Westinghouse Electric & Mfg. Co. —1500 c.p. (15,000 lumen) Mazda C lamp—Height to light source 13 ft.



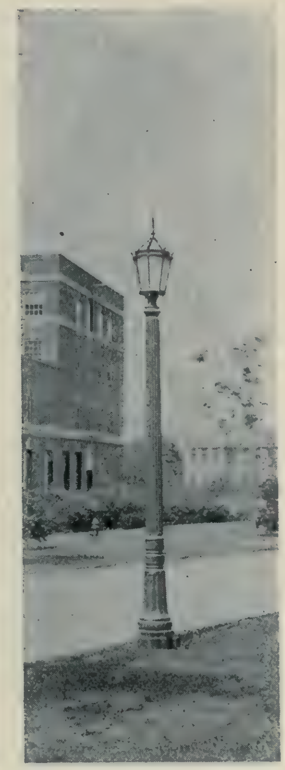
No. 7

Form 23 Novalux lantern unit with Colonial alabaster glass panels and dome refractor, made by General Electric Co.—Pressed steel standard, Design No. 842, made by The Union Metal Mfg. Co.—1500 c.p. (15,000 lumen) MAZDA C lamp—Height to light source 15 ft.



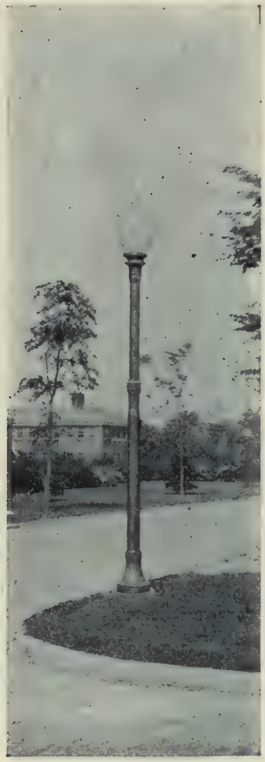
No. 8

Egyptian unit with Alba glass globe and cast-iron standard, Design Commercial, made by Geo. Cutter Works of Westinghouse Electric & Mfg. Co.—1500 c.p. (15,000 lumen) MAZDA C lamp—Height to light source 13 ft.



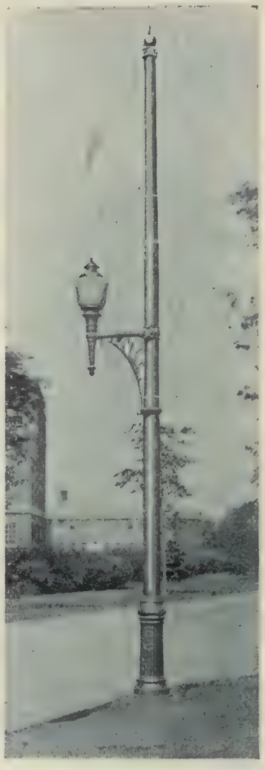
No. 9

Form 18 Novalux lantern unit with clear rippled glass panels and dome refractor, made by General Electric Co.—Cast-iron standard, Design No. 40, made by King Mfg. Co.—1500 c.p. (15,000 lumen) MAZDA C lamp—Height to light source 14 ft.



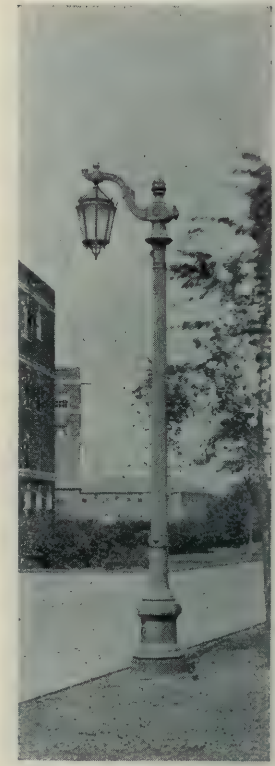
No. 10

Form 16 Novalux unit with No. 97 Genco glass globe and canopy, made by General Electric Co.—Tubular steel standard, Design No. 10814A, made by Electric Railway Equipment Co.—1500 c.p. (15,000 lumen) Mazda C lamp—Height to light source 13½ ft.



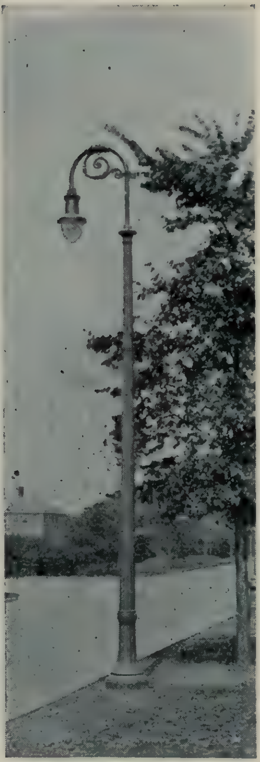
No. 11

Form 16 Novalux unit with No. 37 Genco glass globe and metal canopy, made by General Electric Co.—Elreco tubular steel combination railway and lighting standard and bracket, Design No. 10462, made by The Electric Railway Equipment Co.—1000 c.p. (10,000 lumen) Mazda C lamp—Height to light source 15 ft.—Length of bracket 2½ ft.



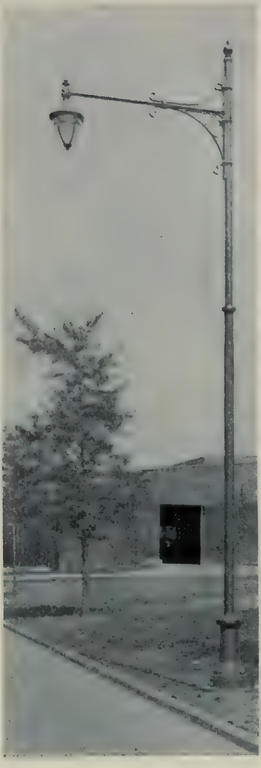
No. 12

Form 19 Novalux lantern unit with clear rippled glass panels and dome refractor, made by General Electric Co.—Pressed steel standard with bracket, Design No. 1106, made by The Union Metal Mfg. Co.—1000 c.p. (10,000 lumen) Mazda C lamp—Height to light source 18 ft.—Length of bracket arm 2½ ft.



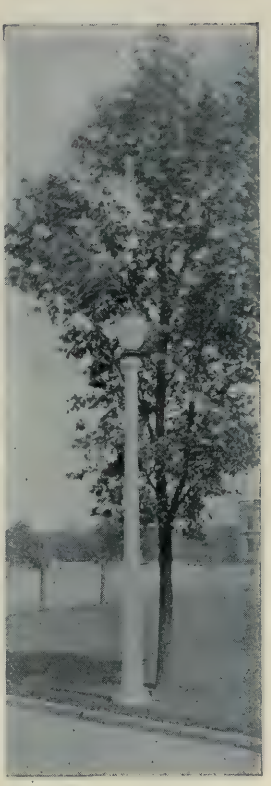
No. 13

Form 6 Novalux unit with No. 116 clear rippled glass globe and dome refractor, made by General Electric Co.—Pressed steel standard, Design No. 895, made by The Union Metal Mfg. Co.—1000 c.p. (10,000 lumen) Mazda C lamp—Height to light source 18 ft.—Length of bracket arm 2 ft.



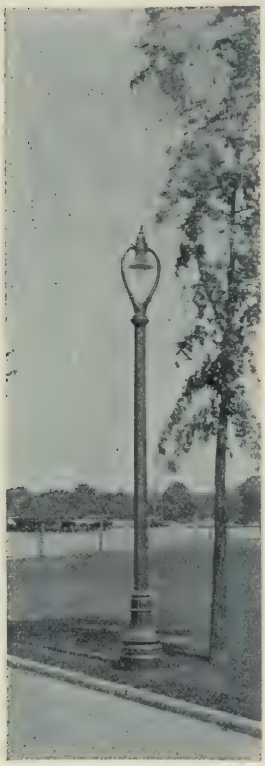
No. 14

Form 25 Large Novalux basket style unit with light alabaster rippled glass globe and dome refractor, made by General Electric Co.—Tubular steel standard, Design No. 1260, made by The Union Metal Mfg. Co.—1000 c.p. (10,000 lumen) Mazda C lamp—Height to light source 20 ft.—Length of bracket arm 6 ft.



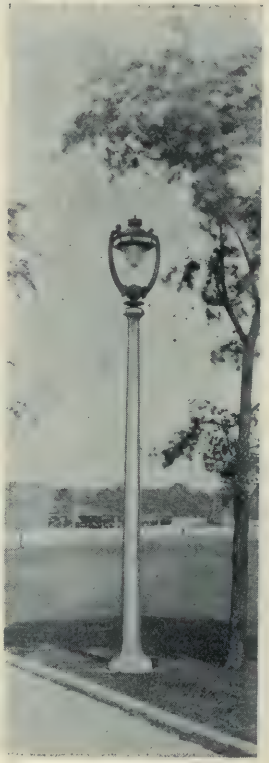
No. 15

Bowlolite—three-piece glass refractor unit, made by Holophane Glass Co.—Metal fixture parts made by Line Material Co.—Concrete post, Design No. 0-13, made by Massey Concrete Products Corp.—400 c.p. (4000 lumen) Mazda C lamp—Height to light source 14 ft.



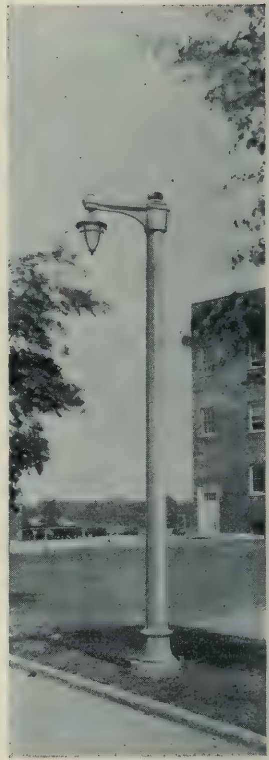
No. 16

Form 17 Novalux Harp type unit, made by General Electric Co.—Cast-iron standard, Design No. 45, made by King Mfg. Co.—400 c.p. (4000 lumen) MAZDA C lamp—Height to light source 14½ ft.



No. 17

Milwaukee Harp one-piece glass refractor unit made by Holophane Glass Co.—Metal fixture parts made by Line Material Co.—Concrete post, Design No. 0-13, made by Massey Concrete Products Corp.—400 c.p. (4000 lumen) MAZDA C lamp—Height to light source 15 ft.



No. 18

Form 25 small basket style Novalux fixture with light alabaster rippled glass globe and dome refractor, made by General Electric Co.—Concrete bracket standard, made by the Massey Concrete Products Corp.—400 c.p. (4000 lumen) MAZDA C lamp—Height to light source 16 ft.—Length of bracket arm 2½ ft.

MODERN REQUIREMENTS IN STREET LIGHTING

By Thomas W. Rolph[*]

We are in the midst of a period of active and far-reaching change in street lighting practice. Former standards of what constitutes good street lighting are no longer considered adequate for meeting the needs of the present day. New and higher standards have appeared and our cities are striving to meet them. Excellent progress has been made, but there is still much to be done before the goal is reached.

Two lines of development have led to this new era.

Changes in Social Habits

Within the last twenty years city transportation has been revolutionized by the automobile.

In 1899 there were 3,700 automobiles in the United States; in 1903, 11,000; in 1914, 1,250,000; in 1920, 7,900,000.

Not only is this increase continuing but it is accelerating. Automobile production in 1922 will probably exceed the total number of cars in use in 1916.

This means an enormous increase and a continuing and perhaps accelerating increase in the amount of traffic, in the speed of traffic and in the danger to human life.

Advances in the Science of Illumination

It is only 40 years ago that arc lamps first began to be used for street lighting.

It is only 25 years ago that gas mantles were first used for street lighting.

It is only 15 years since the appearance of the tungsten incandescent lamp with its remarkable increase in efficiency over the older types.

Eight years ago the first gas filled incandescent lamp appeared.

Co-incidentally the first of the modern types of prismatic refractors was developed for street lighting, making it possible to distribute the light of

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[*] Managing Engineer, Street Lighting Department, Holophane Glass Company, New York City.

In 1906, 400 deaths were caused by automobiles in the United States; in 1920, 10,000.[1]

An investigation of traffic accidents in 32 large cities indicated that 17.6 per cent of all traffic accidents are due to inadequate street lighting.[2]

Another large factor in the increase in the use of the streets by night has been the development of the moving picture industry. In a brief span of 20 years this industry has grown to the point of providing low-cost evening entertainment for millions of people.

With the increase in population of the United States, the increase in city population has been more rapid than the increase in rural population. Furthermore, the increase in suburban population has outstripped the increase in actual city population due to modern facilities for rapid daily transportation into and out of the city.

The Result of all these changes in our social habits is the appearance of a legitimate and increasingly insistent demand on the part of the public that the streets of our cities be made essentially as safe and convenient by night as by day.

the lamp efficiently and evenly over wide areas.

Since them, many types of refractors have been designed and the accurate control of light for street lighting has become a practical and effective accomplishment.

Within 15 years the efficiency of the incandescent lamp has increased 500 per cent.

Within the same period of time advances in the knowledge of how to use light effectively have been scarcely less notable.

The Results of all of these advances in the science of illumination is that the streets of our cities can be made essentially as safe and convenient by night as by day, at a cost which is approximately twice the present average annual expenditure per capita.

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[1] Street Lighting and Public Safety—Earl A. Anderson, American Society for Municipal Improvements, 1921.

[2] Illumination and Traffic Accidents—Earl A. Anderson and O. F. Haas, I. E. S. Convention, 1921.

The questions at once arise, how much light is necessary to provide the required safety and convenience, and what are the costs involved?

The illumination required depends greatly upon the character of the street. A residence street carrying no thru traffic and little traffic of any kind does not need the same degree of illumination as a busy thorofare. Thorofares or arterial highways vary considerably in the amount of traffic which they carry and may conveniently be divided into the two classes of light-traffic thorofares and heavy-traffic thorofares. The greatest traffic and the greatest use of the streets for promenade are usually in the retail business and theater district. The wholesale district carries little pedestrian traffic but often considerable night automobile traffic. Taking all these factors into consideration, the following table has been prepared, giving the illumination values which are considered adequate, according to the high standards towards which we are moving.

TABLE 1

Illumination Required to Make the Streets by Night Essentially as Safe and Convenient as by Day

CLASSIFICATION OF STREET	AVERAGE ILLUMINATION, FOOT-CANDLES	APPROXIMATELY EQUIVALENT TO
Non-traffic streets	0.04–0.05	1½ times full moonlight
Streets outside the retail business district carrying moderate traffic; principally wholesale districts and secondary thorofares	0.12–0.15	4 times full moonlight
Streets outside the retail business district, carrying great traffic; principally the main thorofares to and from the business district	0.20–0.25	7 times full moonlight
Streets in the retail business and theater district and promenade streets	0.50–0.60	16 times full moonlight

It usually happens that for the last class of streets, a higher illumination value than given in this table is desirable, altho not necessary from the standpoint of safety and convenience. A higher illumination than absolutely necessary is pleasing to the users of the streets and has an advertising value both to the mer-

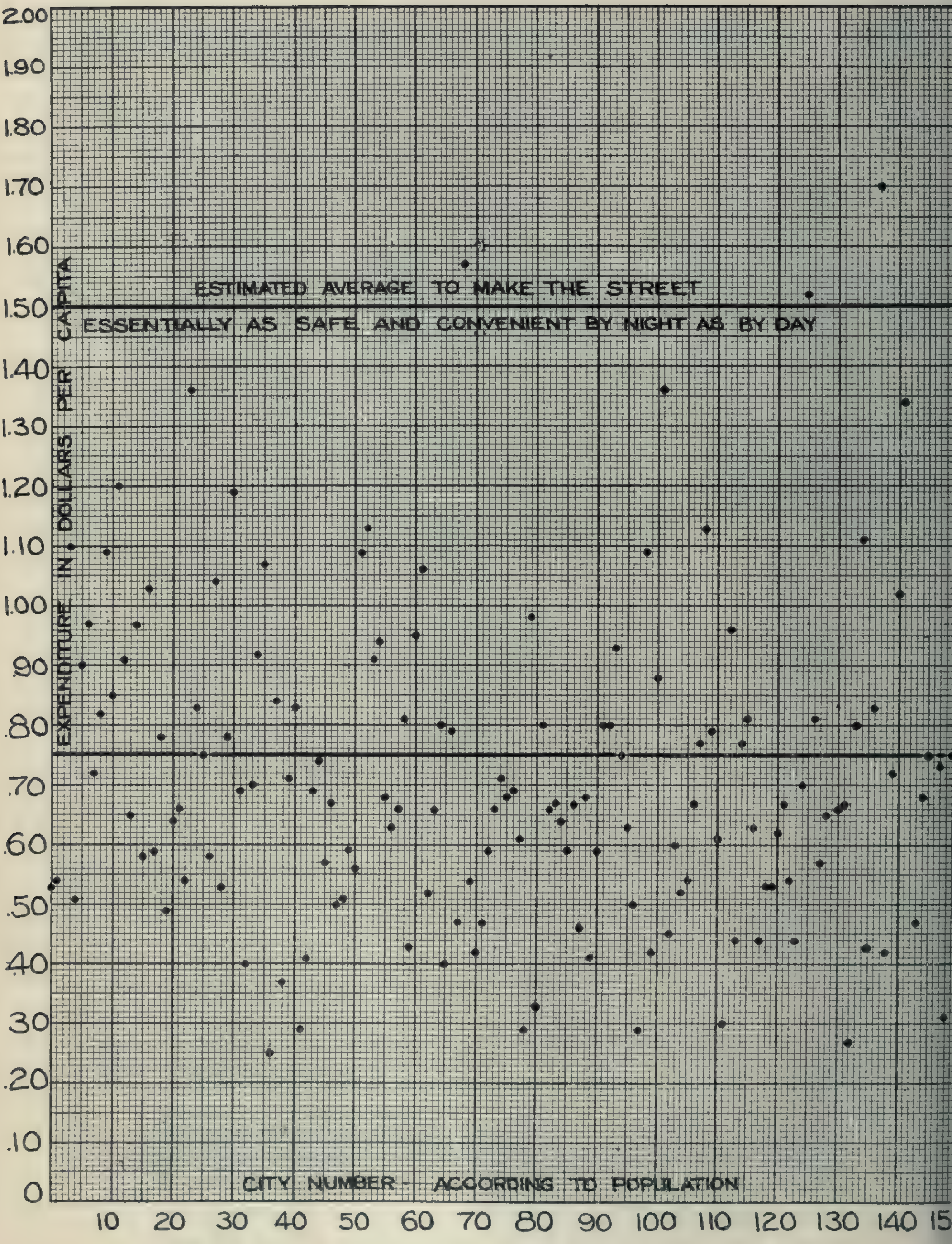

Fig. 1—A. Annual Per Capita Expenditures for Street Lighting.

U. S. cities of over 30,000 population; 247 cities, data on 215. See list of cities on page 369 for name of cities corresponding to numbers in figure.

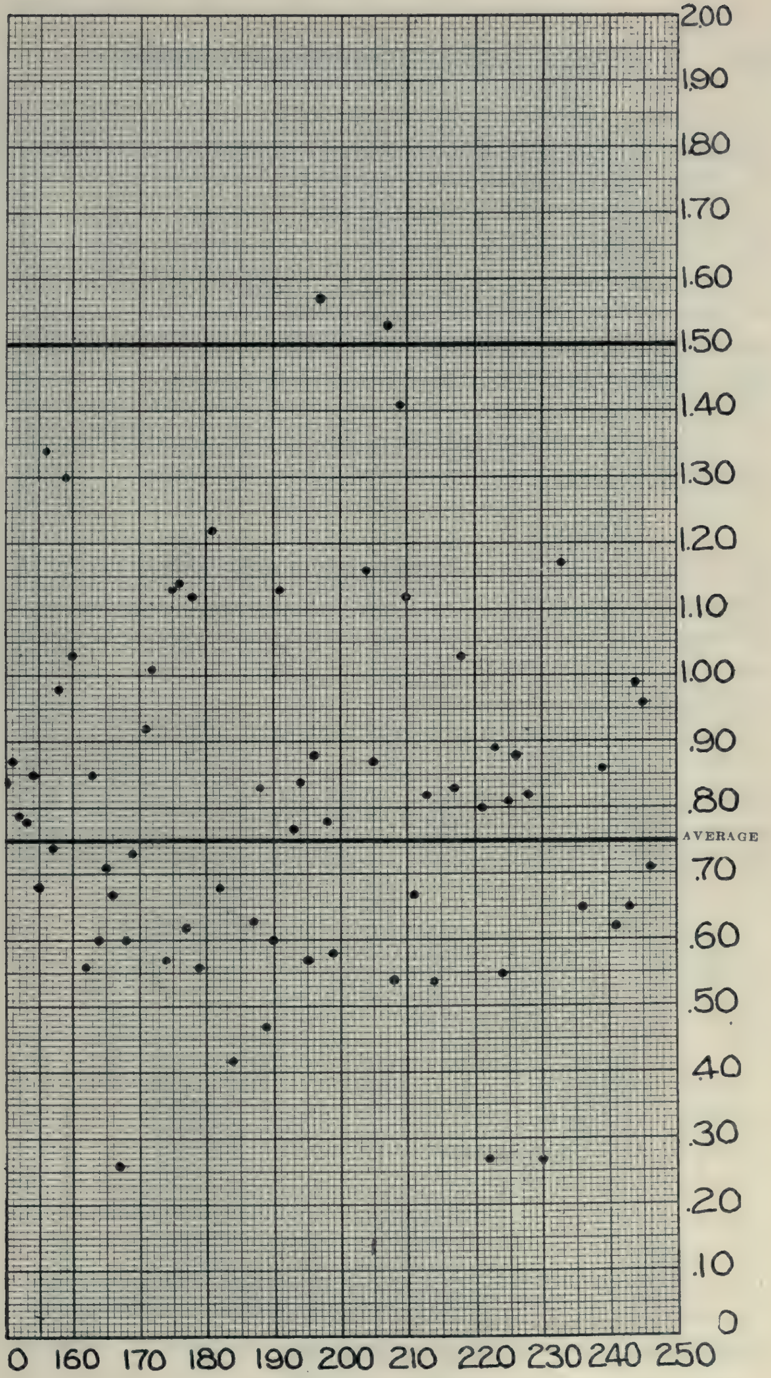

Fig. 1—B, is Fig. 1—A, Continued.

chants of the street and to the city at large. The values given in the table are only the values required to make the streets essentially as safe and convenient by night as by day.

While the value for non-traffic streets seems low, it is probably farther from realization at the present time than the values given for the other classes of streets. Typical—not all—present day practice for non-traffic streets places lights at the majority of street intersections. The street in the immediate vicinity of the light is well illuminated but large areas of comparative darkness intervene between lights.

Arterial highways or thorofares are in some cases well lighted today but in most cases improvement is necessary to bring the illumination up to the figure given.

The popular interest in white-way lighting has had an excellent effect on the lighting of downtown districts. Many cities now have white-way illumination exceeding the values given in the table and the uniformity of illumination on the street is all that could be asked. The general average, however, is less than the values given and there is, consequently, progress still to be made.

The present expenditures of cities for street lighting are instructive for comparing individual cities with each other and with the general average. It cannot, of course, be said that the city which spends more than the average is better lighted than the average and vice-versa. Nevertheless expenditures are roughly indicative of the amount of light used for street lighting in any city.

The latest complete figures for the large and medium size cities of the entire country, are given in a publication issued by the United States Census Bureau, entitled, "Financial Statistics of cities for the Fiscal Year 1919," released by the Census Bureau Sept. 30, 1920, and printed in 1921. These statistics include expenditures for street lighting for all cities which had a population estimated by the Census Bureau in 1919, at 30,000 or over. The census figures of population in 1920 are now available and are more accurate than these population estimates. Applying the 1920 figures of population to the expenditures, a reasonably accurate and complete record is obtained of the expenditure per capita for 215 of the 247 cities in the United States over 30,000 in population. For convenience in studying these figures they have been expressed graphically in the form of the chart shown in figure 1.[3] Each city is represented by a vertical line corresponding to its standing in the list of cities, rated by population, the first line being New York, the second Chicago, the tenth Los Angeles, etc. On each line a dot shows the expenditure per capita for street lighting. The average expenditure for all cities for which the record is available is also shown by a straight line across the diagram. This average is 75¢.

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[3] To increase the reference value of this chart, an appendix is added at the end of this paper, giving the complete list of these cities in their proper order.

Taking into consideration the various cost factors of street lighting and the actual experience of certain extremely well lighted cities, it is estimated that for cities of this class, the streets of the entire city can be made essentially as safe and convenient by night as by day at an average annual per capita cost of $1.50. This figure, which is exactly twice the present average, is also shown on the diagram by a horizontal line. The fact that the city can be so lighted at such a cost does not mean that it will be. This estimate is based on the use of the most efficient lighting equipment installed according to the best modern practice. If inefficiencies in generating the light or using the light are tolerated, or if the luminaires are ineffectively placed, the goal cannot be attained by this expenditure. Either the expenditure must be higher or the illumination will be less than adequate.

The new standards for street lighting are being attained by three factors of improvement.

1. Increase in expenditure,
2. Improved street lighting equipment,
3. Improved street lighting practice.

At the present stage of progress the goal of complete safety and convenience cannot be attained except by increased expenditure. There are a few cities in this list which are spending enough today to attain the goal of daytime safety and convenience. Whether they do attain it or not depends upon to what extent they take advantage of recent improvements in equipment and advances in practice. The great mass of the cities, however, must spend more money if the streets are to be made essentially as safe and convenient by night as by day. It is not always easy to obtain the authorization for this increased expenditure. In many cases it is almost impossible to obtain an immediate increase in expenditure. Consequently it is of the very greatest importance that the second and third possibilities for improvement in street lighting be utilized to the utmost. Some cities at present do utilize the best of modern equipment according to the best modern practice, but taking the country as a whole there is vast room for improvement in this respect. The situation is a serious one. The changes in social habits are with us whether we like it or not. The streets must be lighted to meet the needs of modern society. To a certain extent, human life is at stake. Every factor which will tend to improve the present conditions should be utilized to the utmost.

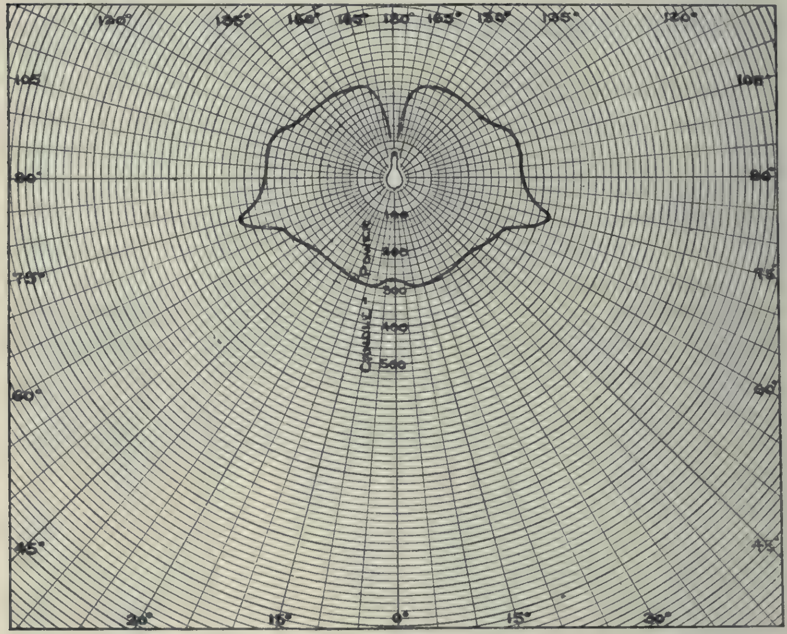

FIG. 2. PHOTOMETRIC CURVE OF 4000–LUMEN (400-C.P.) STREET SERIES INCANDESCENT LAMP.

Consider the factor of efficiency in the use of light. Street lighting lamps in general emit light in all directions. Approximately half the light goes above the horizontal and half below the horizontal. In street lighting where there are no ceilings or walls to serve in some measure as reflectors, the light which goes above the horizontal is almost entirely wasted. It is true that some light is useful, principally from the appearance standpoint, in illuminating trees and buildings. The light required for such a purpose, however, is not large in quantity compared with the total light required to illuminate the street. The proper distribution of the maximum quantity of light over the street is the primary efficiency consideration. Figure 2 shows the photometric curve of the bare incandescent lamp. The 4000-lumen (400-c.p.) street series lamp has been selected as a convenient size to use for reference. It is apparent from the photometric curve that the light in upward directions is about the same in quantity as the light in downward directions.

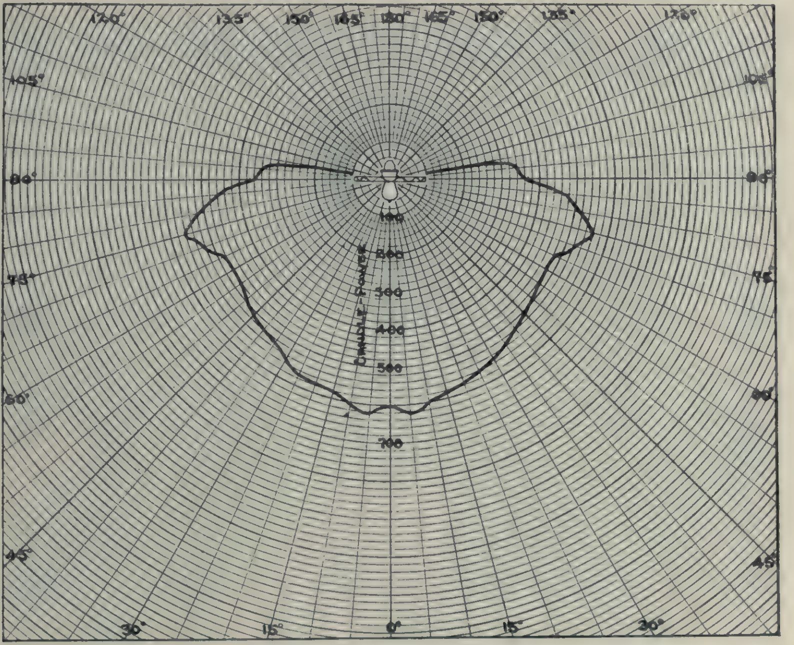

FIG. 3. PHOTOMETRIC CURVE OF 4000–LUMEN (400-C.P.) STREET SERIES INCANDESCENT LAMP WITH FLAT CORRUGATED ENAMELED REFLECTOR.

To modify the distribution of the lamp and improve the appearance of the luminaire, three general types of equiment are used;—reflectors, diffusing glassware and prismatic refractors.

Porcelain enameled reflectors are widely used for non-ornamental lighting. The photometric curve of a typical porcelain enameled reflector with the 4000-lumen lamp is shown in Figure 3. This equipment increases greatly the amount of light below the horizontal, allowing only a small portion to be emitted above the horizontal. However the distribution of illumination over the street area is usually ineffective. The typical installation shows a brightly lighted area of street directly below the lamp shading off into practical darkness between lamps. Common practice places this type of luminaire at street intersections with the distance between lights 16 to 40 times the mounting height. The resulting illumination on the street is such that it reminds one of the practice of certain savage tribes whose members are said to wear a box containing hot embers strapped to the stomach in the winter time. The stomach is effectively warmed but little can be said for the distribution of heat over the entire area desired. Even if lamps with this type of reflector are placed at a distance apart of 12 times the mounting height, which is much better than usual practice, the resulting illumination is far from uniform. Such an impractical spacing as 5 times the mounting height must be used in order to obtain uniformity in distribution of illumination over the street and sidewalks.

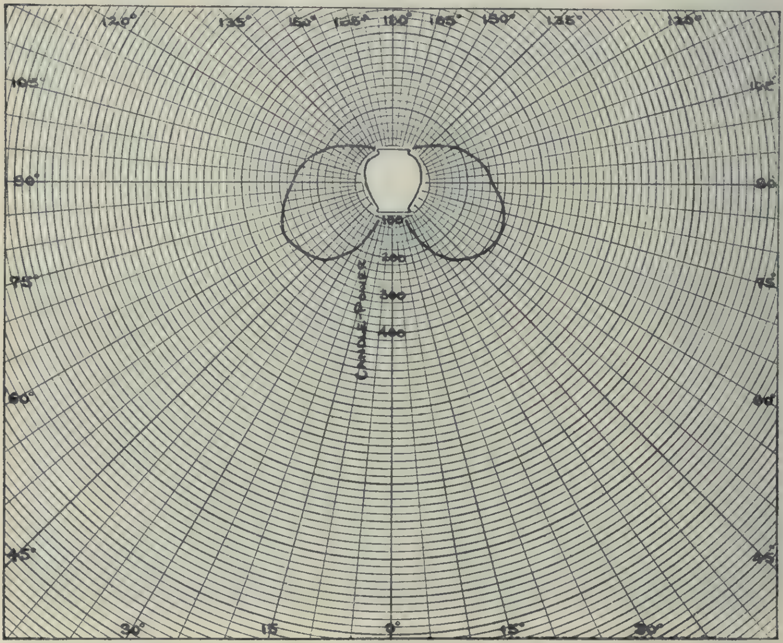

Fig. 4. Photometric Curve of 4000-Lumen (400-c.p.) Street Series Incandescent Lamp with Typical White or Opal Glass Globe.

Figure 4 shows the photometric curve of the 4000-lumen lamp with a typical diffusing globe of white or opal glass. This globe is excellent for the purpose of diffusing the light over its entire surface so that it lights up with a uniform brilliancy. The brilliancy is so much lower than that of the lamp filament that a pleasing effect is produced with less discomfort to the eye. Unfortunately however, this type of glassware is totally lacking in efficiency.

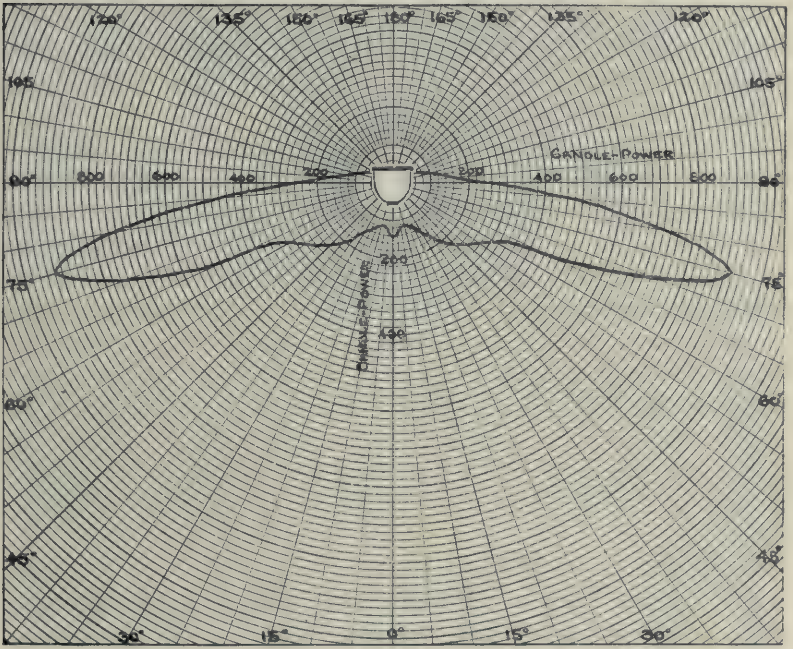

Fig. 5. Photometric Curve of 4000–Lumen (400-c.p.) Street Series Incandescent Lamp with Prismatic Refractor Delivering the Maximum Candle-power at 15° below the Horizontal.

It is apparent from the photometric curve that the candle-power in useful directions is not great and that approximately one half the light is emitted above the horizontal. Considerations of appearance and low initial cost have made this type of glassware popular for ornamental lighting. If efficiency could be neglected, this popularity might be well deserved, but efficiency is of such great importance at the present time, and the performance of the glassware so poor, that the real needs of the day cannot be met by its use.

In figure 5 is shown the photometric curve of a prismatic refractor with the 4000-lumen lamp. This refractor gives the maximum candlepower at 15 degrees below the horizontal. The distribution is such that practically uniform illumination over the street area is obtained at a spacing of 8 times the mounting height. This result is achieved by the prisms which refract the light, directing it far up and down the street. Not only is the distribution of light such as to make approximate uniformity of illumination attainable as a practical matter, but the efficiency in the use of light is good. Little light is emitted from the refractor above the horizontal and the light which is emitted in these directions is sufficient for illuminating the surroundings.

In business-district lighting, a spacing of 8 times the mounting height is common practice today and is to be recommended. In the lighting of other streets, however, a spacing as close as 12 times the mounting height is uncommon. Wider spacings than 12 times the mounting height are scarcely to be recommended, if the ideal of making these streets as safe and convenient by night as by day is to be attained. The lamp position in the refractor can be altered sufficiently to change the distribution of light to that shown in figure 6 where the maximum candle-power is given at 10 degrees below the horizontal. This change results in no appreciable loss in efficiency and a close approach to uniformity in illumination is then obtained at a spacing of 12 times the mounting height.

Combinations of diffusing glassware with refractors are often used. Certain types of refractors used inside of lightly diffusing glass give excellent results, retaining many of the advantages of the refractor with some of the advantages of diffusing glassware. Care must be taken not to use an outer globe which is too diffusing. If dense opal glass is used, the distribution of light from the refractor is completely destroyed, and the lighting result from the combination is no better than from the opal glass alone. With various types of crystal glass giving only a slight diffusion or spreading to the light, a refractor may be used to great advantage. The excellent distribution of light from the refractor is largely retained and the outer envelope gives the luminaire an appearance of size, which could not be attained with a refractor alone except at a greater cost.

In installing street-lighting equipment it is, of course, desirable so to mount the luminaires that glare is at a minimum. The evils of glare from automobile headlights are well known. Street lights also produce glare, often severe, differing from that of headlights only in degree. It is a matter of common knowledge that if any light-source is placed extremely low in a room or on the street, the eye is blinded to a certain degree and cannot see as distinctly. Increasing knowledge along this line, together with increased use of higher candle-power lamps, have revolutionized interior lighting practice in the last 15 years. A similar tendency is apparent in the street-lighting field. While common practice a few years ago used mounting heights of 10 and 12 feet for street lighting, the tendency today is to use considerably higher mounting. Increasing the mounting height is the obvious method of increasing seeing ability or decreasing blinding effect, since it raises the light-source above the line of ordinary vision. Not only does this seem like the obvious remedy, but the best engineering evidence which we have at present shows that it is exactly the proper remedy.

An extensive research on this subject was conducted by the Railroad Commission of Wisconsin in 1914.[4] A level street on the campus of the University of Wisconsin was selected for the tests. Blinding effect was measured in terms of the percent additional illumination required to give equal clearness of vision as compared with fixed conditions under which blinding effect was entirely absent. The tests were of the visual acuity type using squares and circles as test objects. Twenty-one different types of lighting equipment were used at mounting heights from 12 feet to 36 feet, a complete installation of several lamps being tested in each case. Approximately 90,000 readings were taken in the course of the research. It was found that the blinding effect can be expressed roughly by the formula,

$$\text{Blinding effect} = K\sqrt{\text{candle-power}},$$

K being a constant which varies with the mounting height, and candle-power being the average candle-power of the light in the general direction of the eye or between 5 and 15 degrees below the horizontal. Figure 6 shows the curve of K values obtained by this research. The three points which determine the solid line portion of this curve were most accurately determined by approximately 75,000 readings. The 4th point indicated at 36 feet was determined by the test but not checked by as great a number of readings as the other points. The balance of the curve, shown dotted, has been drawn on the basis of corroborative evidence, the tendency of the curve being strongly indicated by the portion accurately determined. The relative blinding effect at different mounting heights is shown in a more pictorial form in figure 8, which is derived directly from the curve in figure 7. American practice is far from standard and the mounting heights shown in figure 8—10 feet to 30 feet—are all to be found on the streets of our cities today. The results of this research give us an indication of what to expect in regard to the blinding effect of glare at various mounting heights. The blinding effect obtained

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[4] Glare as a factor in Street Lighting—Arthur J. Sweet, Electrical Review and Western Electrician, March 6, 1915.

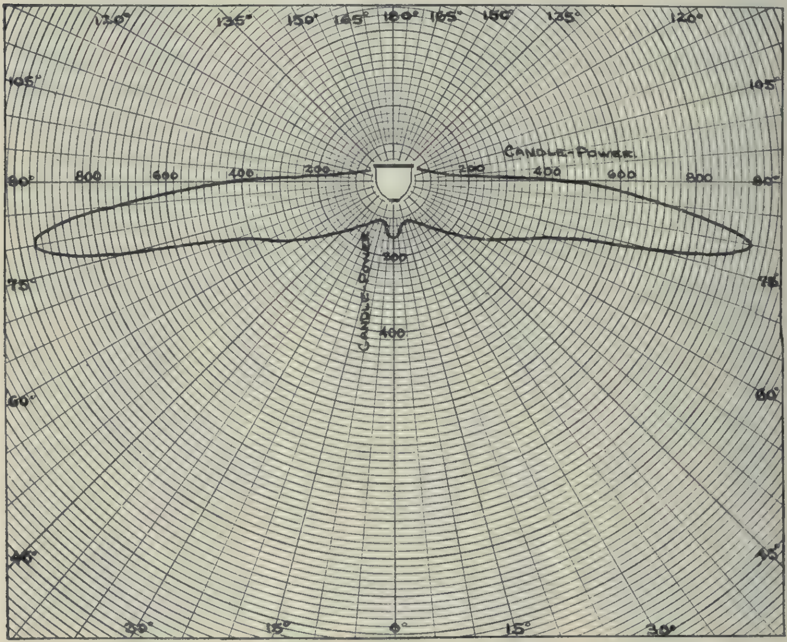

FIG. 6. PHOTOMETRIC CURVE OF 4000-LUMEN (400-C P.) STREET SERIES INCANDESCENT LAMP WITH PRISMATIC REFRACTOR DELIVERING THE MAXIMUM CANDLE-POWER AT 10° BELOW THE HORIZONTAL.

at a mounting height of 10 feet is 3½ times that obtained at a mounting height of 15 feet. Increasing the mounting height from 15 to 22½ feet reduces the blinding effect by one-half. A further increase to 30 feet gives another substantial reduction in the evils of glare.

Blinding effect or decrease in ability to see is just as much a waste of the light as inefficiency in the distribution of the light. Under present conditions, when the highest efficiency we can obtain with present average expenditures does not give enough illumination, it is important that this factor of blinding effect should not be overlooked in determining the mounting heights at which lights should be placed. It would seem that the blinding effect becomes so serious below 15 feet that this height should be taken as a practical minimum for all street lighting. On forested streets standards can usually be placed along the curb line at a mounting height of 15 to 16 feet without undue interference from the foliage. Some trimming of trees is occasionally necessary, but not objectionable trimming. When tree conditions and other conditions permit, it is desirable to use mounting heights considerably greater than 15 feet. The tendency in this direction is indicated by the recent adoption by several progressive cities of mounting heights in the 20 to 30-foot range.

It might be supposed that high mounting heights would lead to high cost of installation, but that is not the case. To distribute the light properly over the street, a definite relation between mounting height and distance apart is used. Refractors for ornamental lighting are usually designed to give uniform illumination at a distance apart of 8 times the mounting height, regardless of what that height is. If follows that with high mounting heights the posts will be further apart than with low mounting heights, and consequently fewer posts will be used. Specifically the relation of spacing to height at typical heights will be

HEIGHT	DISTANCE APART
feet	*feet*
15	120
20	160
25	200
30	240

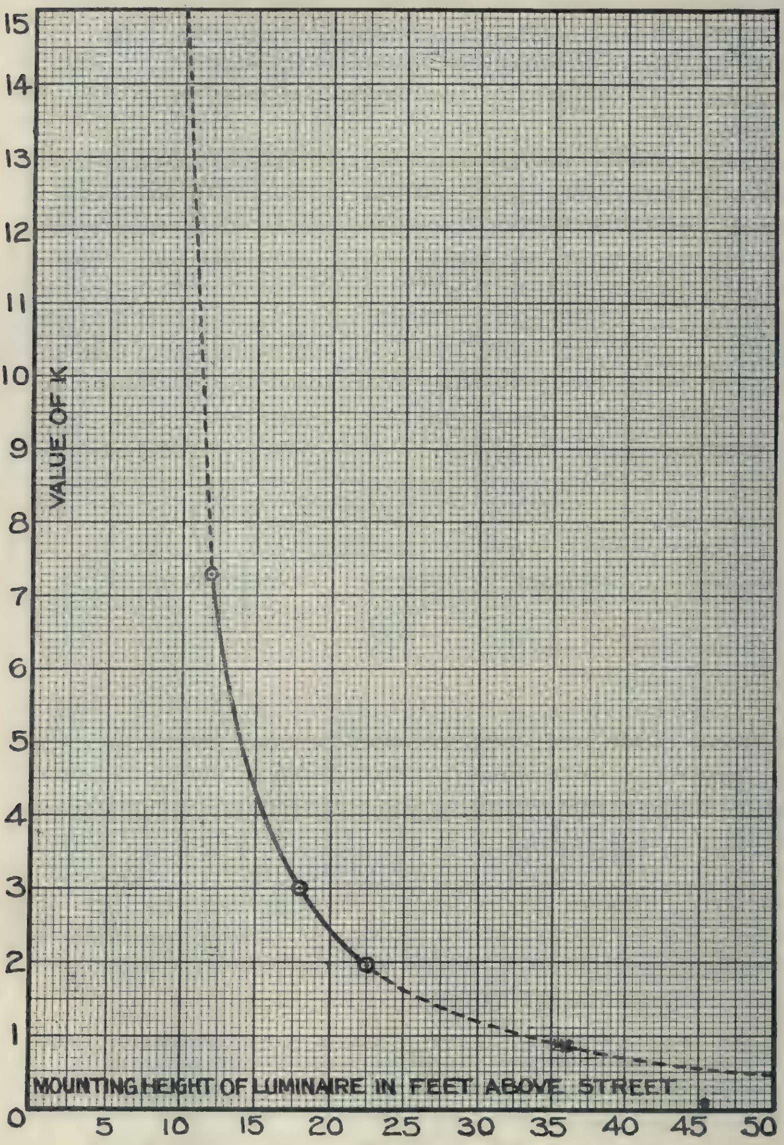

FIG. 7. CURVE SHOWING VALUES OF K IN THE FORMULA
Blinding effect = K $\sqrt{\text{Candle-power}}$,

Blinding effect being measured by percent increased illumination for equal clearness of vision as compared with conditions where blinding effect is absent, and candle-power being taken as to average candle-power emitted by the light between the angles of a 5° and 15° below the horizontal.

This indicates the fewer number of posts used at high as compared with low mounting heights. The result is that installation costs are ordinarily decreased by adopting the greater mounting heights.

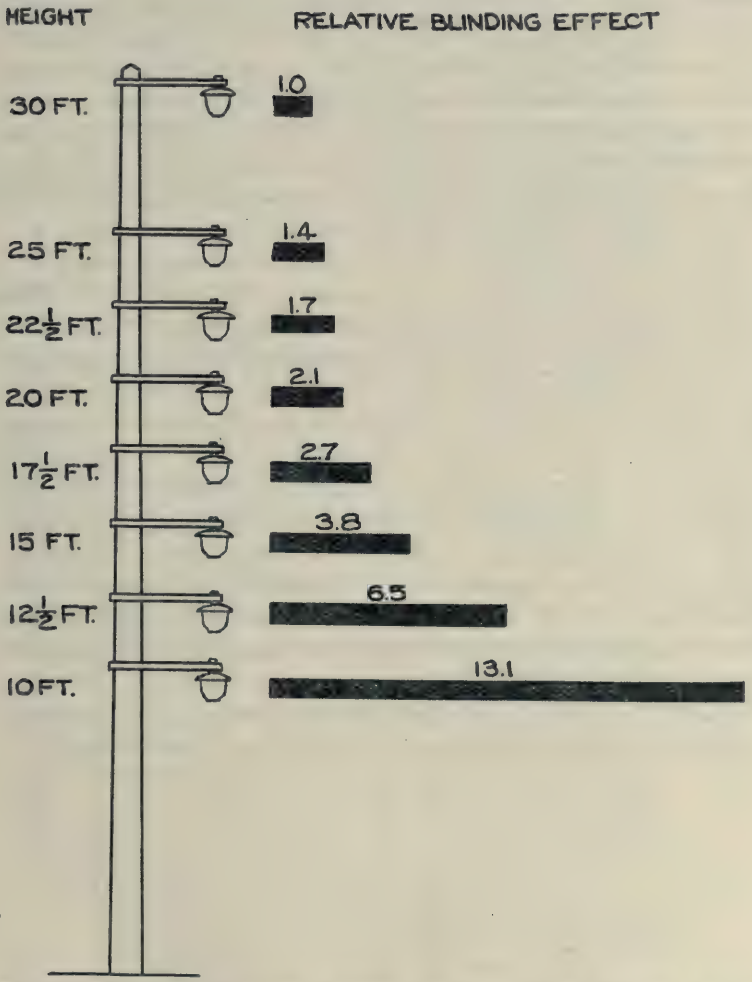

FIG. 8. RELATIVE BLINDING EFFECT OF GLARE FROM STREET LAMPS AT DIFFERENT MOUNTING HEIGHTS; CANDLE-POWER ASSUMED CONSTANT.

In spite of the tremendous importance of the utilitarian side of the street lighting, an importance which approaches that of a matter of life and death, it is, by no means, intended that matters of appearance should be overlooked. They should be given great consideration. The tendency toward using underground construction rather than overhead, even carrying this construction thruout a large part of the residence district, is an extremely desirable tendency. The tendency towards having lamp supports in all parts of the city attractive in appearance is most desirable. At the same time the question of utility is a question of paramount importance and should be so considered. The questions of utility and appearance need not necessarily conflict. None of the recommendations contained in this paper need interfere with obtaining an entirely appropriate and pleasing appearance in the luminaires themselves and the street lighting installation as a whole.

The greatly changed character of the use of the streets over a period of twenty years ago, is apparent. We have the evidence all around us. In order to meet the needs of the new conditions, it is important that we work toward the goal of making the streets essentially as safe and convenient by night as by day, with the idea of using this as a practical goal to be attained in a comparatively brief span of years. The methods are to increase the average lighting expenditure per capita, to make use of the most modern types of equipment for efficiently lighting the street and to make use of the best modern practice in street lighting. Expenditures should be increased where possible, but since average expenditures are not now adequate and cannot in many cases be made immediately adequate, the other methods of obtaining better street lighting become doubly important. Efficient equipment installed according to the best modern practice, will go far in closing the gap between the present need and its fulfilment.

APPENDIX

United States Cities of Over 30,000 Population, 1920 Census

CITY NUMBER	CITY	CITY NUMBER	CITY
1	New York, N. Y.	43	Dayton, O.
2	Chicago, Ill.	44	Bridgeport, Conn.
3	Philadelphia, Pa.	45	Houston, Tex.
4	Detroit, Mich.	46	Hartford, Conn.
5	Cleveland, O.	47	Scranton, Pa.
6	St. Louis, Mo.	48	Grand Rapids, Mich.
7	Boston, Mass.	49	Paterson, N. J.
8	Baltimore, Md.	50	Youngstown, O.
9	Pittsburg, Pa.	51	Springfield, Mass.
10	Los Angeles, Cal.	52	Des Moines, Iowa
11	Buffalo, N. Y.	53	New Bedford, Mass.
12	San Francisco, Cal.	54	Fall River, Mass.
13	Milwaukee, Wis.	55	Trenton, N. J.
14	Washington, D. C.	56	Nashville, Tenn.
15	Newark, N. J.	57	Salt Lake City, Utah
16	Cincinnati, O.	58	Camden, N. J.
17	New Orleans, La.	59	Norfolk, Va.
18	Minneapolis, Minn.	60	Albany, N. Y.
19	Kansas City, Mo.	61	Lowell, Mass.
20	Seattle, Wash.	62	Wilmington, Del.
21	Indianapolis, Ind.	63	Cambridge, Mass.
22	Jersey City, N. J.	64	Reading, Pa.
23	Rochester, N. Y.	65	Fort Worth, Tex.
24	Portland, Ore.	66	Spokane, Wash.
25	Denver, Colo.	67	Kansas City, Kan.
26	Toledo, O.	68	Yonkers, N. Y.
27	Providence, R. I.	69	Lynn, Mass.
28	Columbus, O.	70	Duluth, Minn.
29	Louisville, Ky.	71	Tacoma, Wash.
30	St. Paul, Minn.	72	Elizabeth, N. J.
31	Oakland, Cal.	73	Lawrence, Mass.
32	Akron, O.	74	Utica, N. Y.
33	Atlanta, Ga.	75	Erie, Pa.
34	Omaha, Neb.	76	Somerville, Mass.
35	Worcester, Mass.	77	Waterbury, Conn.
36	Birmingham, Ala.	78	Flint, Mich.
37	Syracuse, N. Y.	79	Jacksonville, Fla.
38	Richmond, Va.	80	Oklahoma City, Okla.
39	New Haven, Conn.	81	Schenectady, N. Y.
40	Memphis, Tenn.	82	Canton, O.
41	San Antonio, Tex.	83	Fort Wayne, Ind.
42	Dallas, Tex.	84	Evansville, Ind.

APPENDIX—*Continued*

CITY NUMBER	CITY	CITY NUMBER	CITY
85	Savannah, Ga.	128	Berkeley, Cal.
86	Manchester, N. H.	129	Long Beach, Cal.
87	St. Joseph, Mo.	130	Gary, Ind.
88	Knoxville, Tenn.	131	Lincoln, Neb.
89	El Paso, Tex.	132	Portsmouth, Va.
90	Bayonne, N. J.	133	Haverhill, Mass.
91	Peoria, Ill.	134	Lancaster, Pa.
92	Harrisburg, Pa.	135	Macon, Ga.
93	San Diego, Cal.	136	Augusta, Ga.
94	Wilkes-Barre, Pa.	137	Tampa, Fla.
95	Allentown, Pa.	138	Roanoke, Va.
96	Wichita, Kan.	139	Niagara Falls, N. Y.
97	Tulsa, Okla.	140	East Orange, N. J.
98	Troy, N. Y.	141	Atlantic City, N. J.
99	Sioux City, Iowa	142	Bethlehem, Pa.
100	South Bend, Ind.	143	Huntington, W. Va.
101	Portland, Me.	144	Topeka, Kan.
102	Hoboken, N. J.	145	Malden, Mass.
103	Charleston, S. C.	146	Hamtramck, Mich.
104	Johnstown, Pa.	147	Kalamazoo, Mich.
105	Binghamton, N. Y.	148	Winston-Salem, N. C.
106	East St. Louis, Ill.	149	Jackson, Mich.
107	Brockton, Mass.	150	Quincy, Mass.
108	Sacramento, Cal.	151	Bay City, Mich.
109	Terre Haute, Ind.	152	York, Pa.
110	Rockford, Ill.	153	McKeesport, Pa.
111	Little Rock, Ark.	154	Highland Park, Mich.
112	Pawtucket, R. I.	155	Charlotte, N. C.
113	Passaic, N. J.	156	Newton, Mass.
114	Saginaw, Mich.	157	Cedar Rapids, Iowa.
115	Springfield, O.	158	Elmira, N. Y.
116	Mobile, Ala.	159	Pasadena, Cal.
117	Altoona, Pa.	160	Fresno, Cal.
118	Holyoke, Mass.	161	Cicero, Ill.
119	New Britain, Conn.	162	New Castle, Pa.
120	Springfield, Ill.	163	Galveston, Texas
121	Racine, Wis.	164	Shreveport, La.
122	Chester, Pa.	165	Decatur, Ill.
123	Chattanooga, Tenn.	166	Woonsocket, R. I.
124	Lansing, Mich.	167	Montgomery, Ala.
125	Covington, Ky.	168	Chelsea, Mass.
126	Davenport, Iowa	169	Pueblo, Colo.
127	Wheeling, W. Va.	170	Mt. Vernon, N. Y.

APPENDIX—*Concluded*

CITY NUMBER	CITY	CITY NUMBER	CITY
171	Salem, Mass.	209	Auburn, N. Y.
172	Pittsfield, Mass.	210	Battle Creek, Mich.
173	Lakewood, O.	211	Council Bluffs, Iowa.
174	Perth Amboy, N. J.	212	Hammond, Ind.
175	Butte, Montana	213	Quincy, Ill.
176	Lexington, Ky.	214	East Chicago, Ind.
177	Lima, O.	215	Newport News, Va.
178	Fitchburg, Mass.	216	Rock Island, Ill.
179	Kenosha, Wis.	217	Poughkeepsie, N. Y.
180	Beaumont, Tex.	218	Austin, Tex.
181	Stockton, Cal.	220	Pontiac, Mich.
182	Everett, Mass.	221	Easton, Pa.
183	Wichita Falls, Tex.	222	Danville, Ill.
184	West Hoboken, N. J.	223	Amsterdam, N. Y.
185	Oak Park, Ill.	224	Wilmington, N. C.
186	Hamilton, O.	225	Orange, N. J.
187	Superior, Wis.	226	Oshkosh, Wis.
188	San Jose, Cal.	227	Portsmouth, O.
189	Springfield, Mo.	228	Ogden, Utah
190	Charleston, W. Va.	229	New Brunswick, N. J.
191	Dubuque, Iowa.	230	Norristown, Pa.
192	Medford, Mass.	231	Hazelton, Pa.
193	Jamestown, N. Y.	232	Lewiston, Me.
194	Waco, Texas	233	Watertown, N. Y.
195	Joliet, Ill.	234	Columbus, Ga.
196	Madison, Wis.	235	Pensacola, Fla.
197	Brookline, Mass.	236	Green Bay, Wis.
198	Columbia, S. C.	237	Petersburg, Va.
199	Lorain, O.	238	Sheboygan, Wis.
200	Evanston, Ill.	239	Waltham, Mass.
201	Taunton, Mass.	240	Moline, Ill.
202	Muskegon, Mich.	241	LaCrosse, Wis.
203	Muncie, Ind.	242	Newburg, N. Y.
204	Aurora, Ill.	243	Muskogee, Okla.
205	Waterloo, Iowa.	244	Newport, R. I.
206	Chicopee, Mass.	245	Colorado Springs, Colo.
207	New Rochelle, N. Y.	246	Lynchburg, Va.
208	Williamsport, Pa.	247	Kokomo, Ind.

NOTES ON THE STREET LIGHTING OF GREATER CLEVELAND

By A. E. Suker, District Lighting Specialist, Cincinnati Office, General Electric Company

The ever-increasing network of street-railway systems and the remarkable growth of the automobile industry in the past decade has led to a great concentration of traffic on the principal thorofares of our cities. This serious congestion has developed new demands in street lighting, as a safety and convenience consideration, as a preventive of crime, and in our parks and boulevards to increase the utility of these community pleasure-centers.

The business districts and thorofares of the smaller cities, heretofore with local traffic of small volume, now have urgent need for modern street-lighting systems, and this is the result of a tremendous growth in tourist traffic and inter-city passenger and truck automobile service.

The White-Way and Edgewater Park systems of Cleveland, Ohio, and the thorofare and residence-district lighting of East Cleveland described briefly in this article are indicative of good street lighting practice, satisfying the demands mentioned above with units that combine illuminating effectiveness with pleasing appearance.

White-Way Lighting

The Cleveland lantern, Fig. 1, is the unit adopted for the White-Way system of Cleveland's heavy-traffic business districts. The unit consists of a high candlepower series mazda lamp enclosed in an octagonal copper lantern. The artistic merit of the lantern and column is due to the work of a city architect; the engineering features were developed by the engineering department of the National Lamp Works of Cleveland. The lantern has a diameter of 20 inches and a length of 30 inches. It is supported at a height of 15 ft. measured from the light source to the street level.

The lamp is suspended tip-down with a prismatic refractor surrounding the bulb. The purpose of this dome refractor is

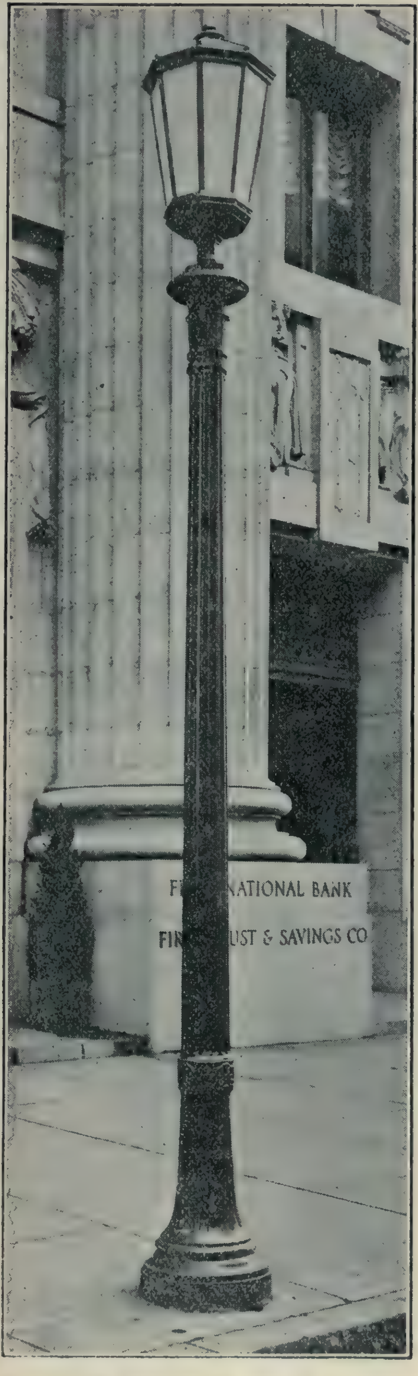

Fig. 1. Cleveland White-Way Unit

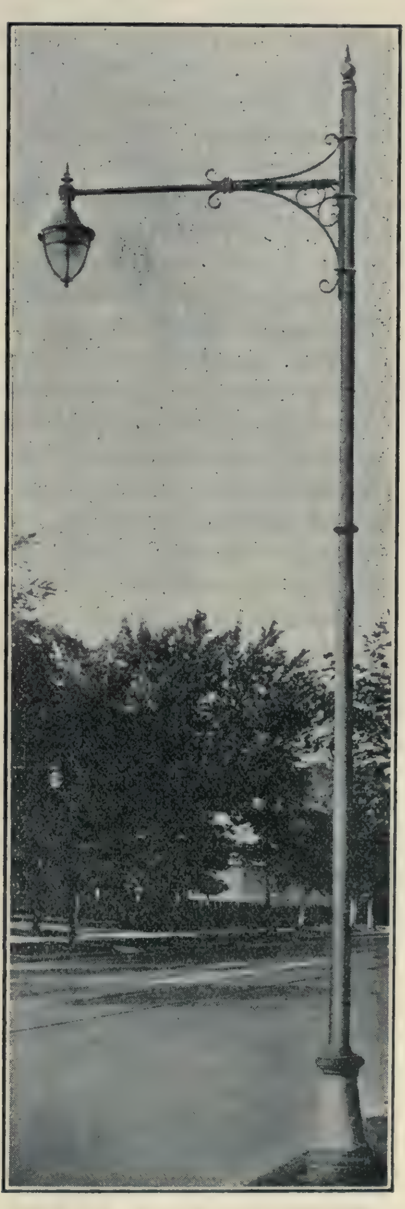

Fig. 2. East Cleveland Lantern and Bracket Standard

to direct the larger proportion of the light to the street surface, allowing just enough upward light to illuminate the facades of the buildings. It prevents glare in the eyes of pedestrians, and it also prevents the formation of a bright band on the buildings at a second-story level, which otherwise would destroy the efficacy of electric signs usually placed at this height. The distribution of light obtained thus is such that the variation in intensity over the entire building facades is so slight as to be scarcely discernible. The panel-glass is slightly opal and it has a rippled surface, which produces a very pleasing sparkle. A slight decrease in the maximum brightness is effected by the small opal content; however, the general variations of brightness over the glass surfaces retain the original motif of lantern design.

The important consideration of maintenance has been well taken care of in the construction of the Cleveland lantern. Dust collection is retarded by having the smooth side of the panel glass outward and by making the fixture very nearly air-tight. A six-weeks cleaning interval was selected as proper for maintaining good lighting conditions, the panel-door construction making easy access to the lantern interior for the replacement of lamps and for the removal of refractors for washing.

Approximately 1,500 such units equipped with 1500-cp. and 1000-cp. mazda C lamps are used in the business district. The units are spaced about 85 ft. apart and they are located opposite each other on both sides of the street. Each standard is equipped with an individual insulating transformer so designed that the 1500-c.p. and 1000-c.p. lamps may be interchanged.

While the basic service performed by this street lighting system is that of accident and crime prevention, Cleveland may be justifiably proud of the practical improvement the White-Way has made in the business sections as regards the convenience and comfort of the pedestrian and the shopper. The White-Way improves the street appearance both by day and by night; hence, it provides favorable conditions for progress and prosperity to the community and to Cleveland.

Edgewater Park System

The designers of the Edgewater Park lighting system recognized that boulevard and park lighting demands the choice of equipment that will advance the civic pride of the citizen and

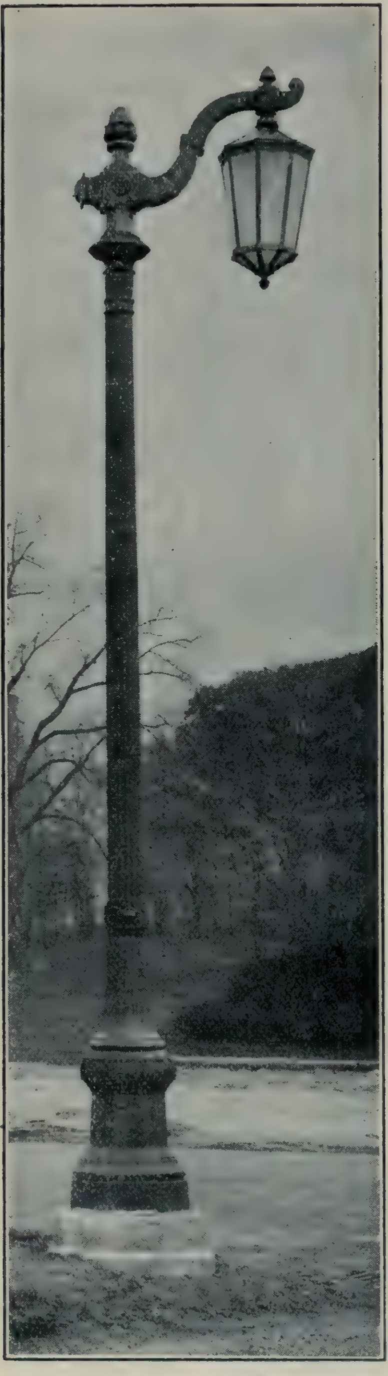

FIG. 3. LANTERN AND POST OF EDGEWATER PARK LIGHTING SYSTEM

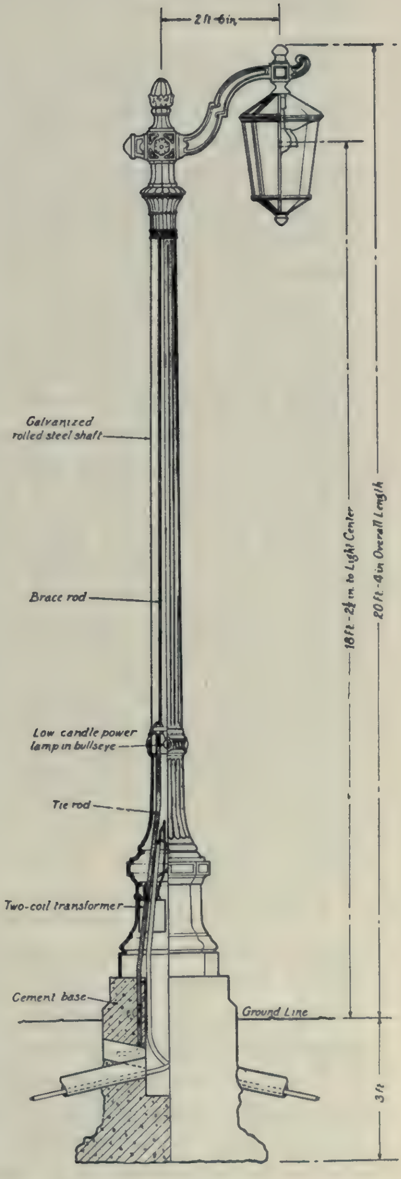
2 ft-6 in
Galvanized rolled steel shaft
Brace rod
Low candle power lamp in bullseye
Tie rod
Two-coil transformer
Cement base
Ground Line
18 ft-2¼ in. to Light Center
20 ft-4 in Overall Length
3 ft

FIG. 4. SECTIONAL VIEW OF EDGEWATER PARK UNIT

create the favorable comment of the visitors to Cleveland's parks. The general satisfaction with which the White-Way lantern was received is exemplified by the fact that the salient features of this lantern are incorporated in the Edgewater Park unit.

The similarity between the Edgewater Park lantern and the White-Way is an important advantage since it makes possible the interchangeability of parts. The top glass section and certain portions of the lanterns as well as the steel column and some of the castings of the standard are exactly alike; hence, the number of parts that must be stocked is considerably reduced. The park unit employs the use of the slightly opal rippled glass of the White-Way unit, which as has been mentioned, gives a pleasing sparkling light. The post design is seen to be slightly more elaborate than that of the "White-Way" standard, the addition of the curved bracket arm supporting the lantern in a pendent position enhancing the good appearance of the unit.

The cleaning schedule planned for the Edgewater Park installation insures the removal of dust and dirt from the glassware by brushing and washing with hot water at intervals of one month. In addition to the monthly cleaning, the schedule provides for inspection, overhauling, and cleaning of the units once every year at the substation. The construction of the lantern is such as to allow the removal of the lantern from the bracket for such purposes. The wiring and socket are a part of the bracket arms; the lantern itself is carried by a bayonet holder. To remove the lantern it is only necessary to unscrew the lamp from the socket, take it out thru the hinged side-door panel, lift the lantern slightly and turn it, which frees it completely. Despite the ease of removal of the lantern, no sacrifice is made in the sturdy construction of the holder.

A frequent cause of accident on the curved drives of parks and boulevards has been the outage of lamps. The presence of areas left in darkness has often resulted in collisions with unlighted standards. The Edgewater Park unit eliminates to a great extent the likelihood of these accidents. In each standard about 6 ft. above the ground, is installed a red glass bull's-eye with a low-wattage lamp connected in multiple with the 600-c.p. lamp off the individual insulating transformer located in the pole. When the large lamp is in operation the signal lamp behind the bull's-eye burns at a very low voltage, and it emits only a faint red glow. Upon the failure of the main lamp, the signal lamp voltage rises to normal on account of the transformer characteristics, and the bull's-eye shines out brightly, thus serving as a warning to drivers.

The Edgewater Park installation involves the use of 600-c.p. mazda C street series lamps. The lantern suspension arms are placed about 20 ft. above the ground, and the standards are spaced approximately 200 ft. apart.

Some 200 of these units are in use at the present time and eventually it is planned to adopt the Edgewater Park system for all Cleveland parks.

East Cleveland System

Euclid Avenue, in East Cleveland, is the most important thorofare and residence-district feeder. It is a 100-ft. street with a double-track street railway. It is lighted by 1000-c.p. lamps in bracket-type standards. This bracket-type standard, with a 6-ft. bracket carrying the lamp at a height of 20 ft., is used on all the wide thorofares of East Cleveland. See Figs. 2 and 5.

Lower mounting heights are satisfactory with 1000-c.p. lamps when employed at close spacings and with the light-colored surroundings characteristic of business district white ways. However, under the conditions of thorofare lighting with wider spacings, where light backgrounds are absent and the general level of illumination is less, 20 ft. is considered the minimum desirable height. The 6-ft. bracket length brings the light source out over the street and greatly reduces the likelihood of interference of light distribution from overhanging foliage. Lamps placed over the curb in this manner illuminate the vertical curb surfaces effectively, and clearly outline the boundaries of the street, an important advantage to motorists.

The top of the lighting unit is a single casting to which is hinged a basket formed of copper bands. The basket serves as a supporting mount for the globe. This globe is of one-piece construction and it has a rippled surface, which gives the effect of innumerable prisms, with a resulting life and sparkle to the lantern. A porcelain-enameled reflector is bolted to the casting inside and this serves the additional purpose of supporting the dome prismatic refractor, which directs the light downward to the street surface.

For thorofare lighting, the bracket posts are spaced on an average of 280 ft. apart on each side of the street and staggered, thus providing one unit for every 140 ft. of street length. The adjoining residential streets are equipped with units on a 200-ft. staggered spacing and 150-watt (approximately 200-c.p.) lamps are employed.

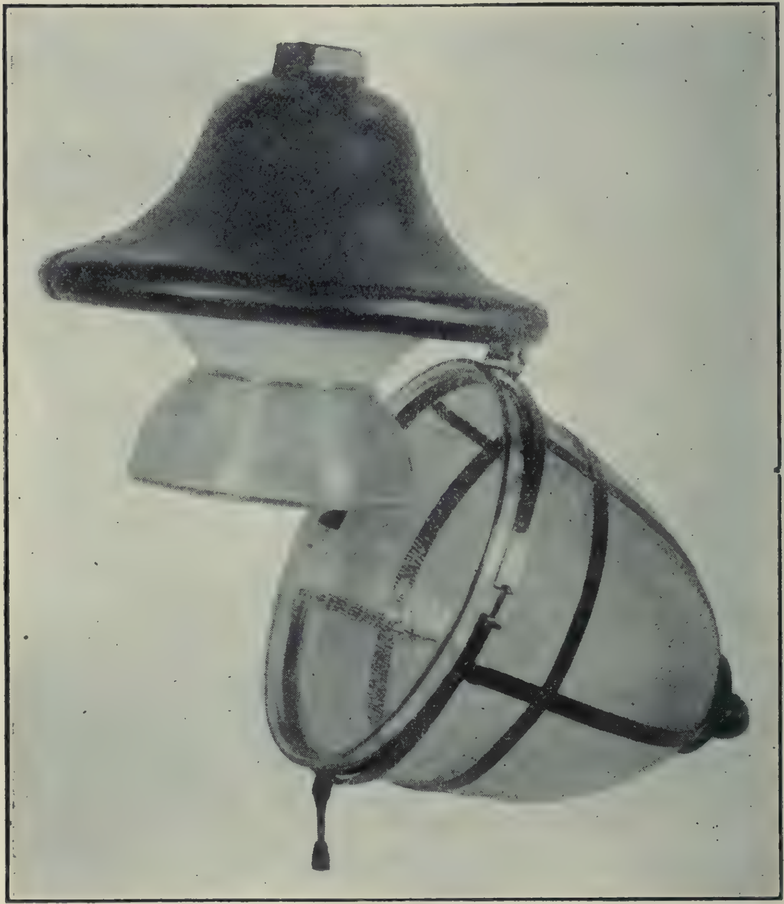

Fig. 5. Interior Construction of Bracket-Type Pendent Refractor Lantern

The same type of standard is used for the narrower residential streets except that the height of the lamp is 16 ft. and the bracket length is 4½ ft.

The lighting provided for East Cleveland is of such quality that an automobile driver is able to see a grown person or child in the street in ample time to avoid accident; passengers are able to gage their footing quickly as they alight from street cars, and as they cross street intersections. In addition, the selected equipment minimizes glare and undue brightness when it is viewed from the porches or upper-story windows, and it lights up front lawns and spaces between houses to such an extent that dark areas and dense shadows are largely avoided. The exigencies of comparatively wide spacing between units, the incident dark surroundings, and the attending interference of overhanging foliage makes this bracket-type pendent lantern a splendid choice.

With a few exceptions, there are no wooden pole lines on the residence streets of East Cleveland. The six hundred-odd residential-street lighting units in the new system are supplied from the existing house-lighting circuits on the rear lot lines. The street-lighting feeders extend underground from these wooden-pole lines, along the side lot-lines, to the street lamp at the curb. Owing to the fact that there were no wooden-pole lines on the streets and therefore a complete new series distribution would have been necessary, the underground multiple system did not greatly exceed in cost the estimated expense of a standard overhead series system.

In conclusion, I wish to emphasize the fact that while the street lighting systems discussed are conspicuous as examples of applied engineering, they are no less noteworthy from the standpoint of artistic design. They stand as a public recognition of the fact that the requirements of modern street lighting are satisfied only when with competent engineering is combined the artist's touch.

REPORT OF COMMITTEE ON TRAFFIC AND TRANSPORTATION

By Arthur H. Blanchard, Chairman, Ann Arbor, Mich.

Your Committee on Traffic and Transportation herewith respectfully submits its 1922 report.

This report is devoted to tentative recommendations which the committee requests be discussed at the 1922 Convention and also asks that members interested in efficient traffic regulation and the economic development of highway transport submit criticisms and suggestions relative to the several subjects presented herewith to the chairman of the committee prior to July 1, 1923, as it is the intention of the committee to present recommendations relative to these subjects for final adoption at the 1923 Convention.

1. Weights and Dimensions of Motor Trucks. Members of the Society are urged to discuss with the members of their state legislatures the following dimension and weight regulations for motor trucks with a view to incorporating sane regulations in state laws which would be effective in all cities within a state passing such legislation.

Maximum width of motor truck chassis or body, 96 inches.

Maximum overall height from base of tire to highest point of vehicle or load, 12 feet 6 inches.

Maximum overall length vehicle, body and load, 30 feet.

Maximum weight per linear inch of width of solid rubber tires, measured at the base of the rubber, 800 pounds.

Maximum gross weight on one axle, 22,000 pounds.

Maximum gross weight of motor truck and load, 28,000 pounds.

In its 1923 report, your committee intends to present recommendations pertaining to trailers and maximum speeds for motor trucks and trailers operating within cities on different classes of streets for different types of motor trucks and trailers and would appreciate the coöperation of members of the Society in submitting recommendations to its chairman before July 1, 1923.

2. Financing of the Reconstruction of Streets. Your committee submits, for your consideration, the proposal that the cost of reconstructing pavements and foundations on streets, in business districts and main thru trunk thorofares be financed by general appropriations and in no cases of such streets by assessment against abutting property.

3. License Fees for Motor Vehicles. Your committee asks criticisms of the following tentative conclusion: That no license fees be charged for the operation or ownership of motor vehicles by any city but that all such license fees should be collected by the State and that a certain proportion thereof should be distributed to the cities by the State and be credited to the street maintenance funds.

4. Franchises for Freight and Passenger Highway Transport Intercity and Rural Express Companies. Your committee tentatively recommends that each highway-transport company operating an express-freight or passenger service on a definite route and in accordance with a time schedule should be required to obtain a franchise from a State Commission, particularly appointed for this purpose, and should be required to secure the permission of all cities thru which it operates to use a definitely prescribed route therein.

5. Sign Posting for thru Routes in Municipalities. Your committee suggests that, at all corners at which turns are made on thru routes in municipalities, direction signs be erected and, at the city limit on each route, a large map be erected, which will show the plan of all thru routes in the municipality, giving the names of the streets and the principal adjoining cities to which each route leads.

6. Safety Car-Stop Zones. Your committee tentatively recommends that raised car-stop safety zones be universally employed in place of safety zones designated by limit lines, stanchions or mushrooms. Your committee also recommends that no stopping, ranking or parking be allowed at the curb opposite the safety zones and for a distance of ten feet each side of the safety zones.

7. Railroad Grade Crossings within Municipalities. Railroad grade crossings are a constant source of accidents. It is evident that their total elimination is desirable but unfortunately is not practicable in all cases in the present state of the financing of highway improvements. Much can be done by proper design to reduce traffic hazards in the case of railroads crossing highways at grade. A clear sight of the railroad crossing for five hundred feet on each side materially reduces accidents and a clear sight of the railroad for a thousand feet on each side of the highway is desirable. The width of all roadways crossing railroads should be at least twenty feet. For a distance of one hundred feet on each side of the railroad, the grade of the highway should be level or not over two feet rise or fall in one hundred feet. The suggestion by some officials to construct humps in the highway to slow down traffic approaching railroad crossings is unreservedly characterized as pernicious.

Proper danger signs should be located at two hundred feet each side of grade crossings in municipalities and, in sections which are poorly lighted at night, a large electrically lighted rectangular sign carrying the word "Danger" in red letters should be suspended directly over the center of the street at the grade crossing.

8. Traffic Regulations for Municipalities. Your committee recommends the adoption, as far as practicable, of uniform traffic regulations for vehicles and pedestrians in municipalities. It is the intention of the committee to present a complete set of fundamental regulations in its 1923 report. In this report, there are included only regulations relative to which there may be differences of opinion. It is requested that the members of the Society discuss these regulations with the Chief of Police of the city in which they reside and submit suggestions and criticisms to the chairman of the committee prior to July 1, 1923.

9. Vehicular Traffic Regulations. No person shall operate an automobile, motor cycle or other motor vehicle on any street or public highway in the business or public highway in the business portion of the municipality at a greater rate of speed than fifteen miles an hour or on any boulevard, drive or parkway at a greater rate of speed than fifteen miles an hour, provided such parkway or boulevard drive shall have signs placed at the entrance thereof to indicate such rate of speed, or on any street or public highway elsewhere in the municipality at a greater rate of speed than twenty miles an hour.

Vehicles turning to the left into another street shall pass to the right of and beyond the center of street intersections, before turning, and in congested districts where traffic policemen are stationed at street intersections, an approaching automobile or vehicle shall signal the officer and shall not pass such officer until receiving proper signal from said officer.

Any person or persons operating or driving any motor vehicle or other vehicle shall, at the intersection of any public street or highway, within the limits of the muncipality, keep to the right of the intersection of the center of such street or highway when turning to the right of such intersection.

When vehicles approach an intersection of two or more public streets or highways, the vehicle approaching from the right of the driver shall have the right of way.

No vehicle shall turn to proceed in the opposite direction except at street intersections.

A vehicle shall not stop on a crosswalk nor within the intersection of two or more roadways.

No vehicle shall stop on any street, except within one foot of the curb, or in such way as to obstruct free passage on the street, provided that this rule shall not apply when a driver of a vehicle is compelled to stop for a standing street car.

Drivers of motor vehicles before starting, turning, stopping, backing or changing their course, shall make sure that such movement can be made with safety and shall give definite visible signal of such intention.

No vehicle shall stop anywhere in the city with its left side to the curb.

Each bicycle shall be equipped with a suitable horn or bell for giving warning or signal of its approach and, during the hours when lights on the streets are lighted, shall be equipped with a suitable head light.

The Chief of Police may, from to time, prohibit or regulate the stopping, ranking or parking of motor vehicles or other vehicles in any district where such stopping, ranking or parking will interfere with traffic or the public safety, and no vehicle shall be parked at any time within fifteen feet of any fire hydrant.

Not more than two persons shall occupy the front or driver's seat of an automobile, except that a child less than ten years of age may occupy the front or driver's seat as a third person and no person, adult or minor, shall be seated in the lap of the driver nor shall the driver be seated in the lap of a person when the automobile is in motion.

No motor vehicle having an over-all length greater than twenty feet shall be diagonally or perpendicularly parked at a street curb except when loading or unloading.

10. Pedestrian Traffic Regulations. Except where safety zones are established, pedestrians shall stand on the sidewalk while waiting for street cars until the street car is within two hundred (200) feet or less from the stopping place and when alighting from street cars pedestrians shall not stand in the street but shall proceed immediately to the sidewalk to the right, except where safety zones are provided.

Pedestrians shall not step from the sidewalk nor from between or back of vehicles in crossing a street without looking in both directions to see approaching vehicles, and shall cross only at right angles with the street.

It shall be the duty of all pedestrians to observe the line of traffic at street intersections and to obey the signals of policemen who are directing the movement of such traffic and they shall not cross before the signal is given for the traffic to move in the direction toward which the pedestrians are crossing.

Pedestrians shall not cross street intersections diagonally but they shall cross only one street at a time, using a crosswalk, if designated, or otherwise shall cross at right angles with the street.

Pedestrians crossing the street in the congested district or the business district or crossing any main thorofare, shall do so only at street intersections or cross walks. Pedestrians crossing any street at a point other than a street intersection or cross walk outside of the congested district or business district or main thorofares shall exercise due diligence for their own protection and safety.

DISCUSSION

Mr. Blanchard made the following interpolations in reading the report, the numbers referring to the corresponding numbers of subdivisions of the report above:

Mr. Blanchard: Allow me to state that this report does not contain recommendations to be adopted. At the conclusion of the report, the chairman will move that the report be received. You will note that the subjects covered are presented in a very brief manner, in order to bring them to your attention.

The committee desires very careful consideration of all these subjects, full criticism and the submission of suggestions during the next few months in order that at the 1923 Convention the committee may formulate certain definite conclusions relative to these various subjects. We will, without doubt, be able to send reprints of this report to those we believe will be interested in them, and will request at that time that very definite criticisms and suggestions be submitted.

2. This subject is presented because of the practice that has been handed down thru the ages in municipalities of assessing cost of reconstruction against abutting property, independent of the character of the street.

3. The practice is becoming chaotic thruout the United States as in some states operation of motor vehicles is encumbered by license fees, assessed by the state, and also by cities, and sometimes by counties. The result is, therefore, highly unsatisfactory from an economic standpoint and unjustifiable from a viewpoint of sane, economic distribution of the license fees on motor vehicles.

4. You understand that this recommendation will also carry the guaranty of the state that only such companies as possess franchises will be allowed to operate on a given route, according to a prescribed schedule. In other words, the paying of the franchise fee will be compensated for by a guaranty against wildcat ventures in highway transport, which is having such a detrimental effect at the present time.

7. Your committee, next year, when they present a definite conclusion on this subject, will also give you startling statistics in regard to railroad accidents at grade crossings.

9. The regulation giving right of way to the motor from the right will require a great deal of consideration, because it revolutionizes the traffic regulations in many cities, but now that we are not limited to the stone walls on the corporate limits of a city, so far as the operation of automobiles is concerned, it is extremely difficult for the operator to conform to all traffic regulations, everywhere. You know that you are presented with a problem that you can not solve in entering different cities unless you have taken precaution to secure copies of the traffic laws and studied them carefully.

The next regulation prohibits turning within a block. One comment in regard to traffic regulations: All our laws, national, state or municipal, are adopted on the basis of the good of the large majority. There are, without doubt, many people in this audience who never would cause an accident by turning around within a block, but there are hundreds that do so without giving any heed to other vehicles or traffic on the street, causing very serious accidents and confusion by the unnecessary blocking of traffic. There are other regulations of that same general nature.

Your committee will investigate this subject of bicycle lighting to see if it is practicable to require bicycles to be equipped with a tail light.

There is a difference of opinion in regard to the distance from hydrant. Some municipalities are allowing ten, others going up to twenty-five feet. Fifteen feet is based on investigations in several cities, with the coöperation of Fire Departments, as both required space necessary to get up to a fire plug and operate efficiently.

In other words, any vehicle over twenty feet in length must rank when parked, except when loading or unloading. Parking means parallel to the curb, parking, diagonally or perpendicularly to the curb.

10. One thing I wish to say in connection with the tentative suggestions pertaining to regulations of pedestrian traffic; the responsibility for accidents has been placed entirely upon the operators of vehicles. We have got to educate, beginning with our school children and continuing thru to our adults, to impress upon them their responsibility. The passage of regulations covering pedestrian traffic does not mean that it is going to be practicable for a police department to enforce all of the regulations on all of the streets, but it does give protection to the operator of vehicles and tends, as it has in the City of Cleveland, to improve the conduct of pedestrians in crossing streets.

I spent sometime here in going around the city of Cleveland, and I have been very favorably impressed with the increased care taken by pedestrians as compared with the conditions a year ago, when I made a similar investigation.

Mr. Mullen: It does seem to me, in listening to Professor Blanchard, that we are leading the pedestrian into a good deal of trouble if we throw upon him the responsibility of taking due care, as it is usually stated, even at street crossings where there is no traffic officer. If the entire responsibility is thrown upon the pedestrian it means in a lawsuit he will have to prove due care, instead of the driver of the vehicle which may have injured him having to prove absolute negligence, and I would like to hear from Professor Blanchard on that one point.

MR. BLANCHARD: Some courts have already taken the stand outlined by Mr. Mullen. I have in mind several cases that have recently come up in the city of Detroit, where pedestrians have dodged out, without looking either way, from between vehicles which have been ranked along the curb and have been hit by motor vehicles operated with the utmost care. It is simply impossible to prevent accidents on some streets under such conditions. The same is true of jaywalking at intersections. It is extremely difficult for a motorist to have any idea as to what a pedestrian is going to do, if the pedestrian is allowed to walk all over an intersection. They should not continue to use the streets on the supposition, which seems to be in the minds of a great many, that they can do as their fancy dictates and that the operators of vehicles must assume all the responsibility.

MR. MULLEN: That isn't quite meeting my point as I had it in mind. I am quite certain that people are going to do as they please, regardless of regulations, but I do think that the burden of care should be on the automobilist at street intersections where a person is walking across at right angles within the prescribed limits. The burden of care there should be on the driver of the vehicle. When jumping out from between cars, jaywalking, or cutting diagonally across the intersection, the pedestrian must take what comes to him in the due course of events, but he should be protected at a crossing when he is going across in the proper way.

I understood that you required him to be careful, and if regulations to that effect were passed, the pedestrian would have the burden of proof of care at every intersection crossed.

PRESIDENT RANKIN: As I understand it, that is just the point that the Professor is making, where a pedestrian is not taking proper care, crossing at points other than the street intersection, or crossing diagonally at the street intersection, the proof is up to the pedestrian. It seems to me that it is a very wise provision. I know of a great many cases where drivers have been fined for accidents that were simply impossible for them to prevent.

ADOPTED CHANGES IN THE CONSTITUTION

The following changes in the Constitution were presented in due form as provided by the Constitution itself at the first session of the Convention of the American Society for Municipal Improvements held on October 3, 1922, at Cleveland, O. They were adopted by the unanimous vote of the Convention at the session held on the morning of October 4, 1922, and passed by letter ballot of the active members. The report of the vote will be found on page 402.

Amend Article II, *Section 2*, by inserting after the words, "county or state department work" the words, "or any engineer employed by any street railway company, or any other public utility, operating in any city street, county or state road."

Amend Article IV, *Section 4*, of the Constitution to read. "The Executive Committee shall at some time during the Convention decide on the number and names of the several committees, General and Specification, also on the number of members which shall constitute each committee, to serve during the ensuing year.

In addition to the General Committees on Municipal Improvements and on Specifications, to be determined by the Executive Committee, there shall be a committee on Convention Papers of which the Secretary and President shall be members, a Committee on Convention arrangements of which the Chairman shall be a resident of the city in which the next following Convention is to be held, provided there is a member of the Society residing in that city: a Committee on Publicity of which the Secretary shall be Chairman, and a Committee on Membership. The number of members to be appointed to serve on these committees shall be left to the discretion of the President.

The incoming President shall as soon as possible after his election appoint the members of the several committees from the membership of the Society. Provided, however, that all Committees on specifications shall consist exclusively of Active Members.

The President may also appoint at his discretion one or more members to represent this Society at meetings or Conventions of other Societies or Associations. He is not, however, authorized to obligate the Society to any expense due to such representation without the consent of the Executive Committee.

Article VI, *Section 6*. Omit "Nos. 1 to 10 inclusive."

Article VI, *Section 8*. Omit "of which the President shall be a member."

SPECIFICATIONS FOR SUB-GRADES AND FOUNDATIONS FOR PAVEMENTS

Note: The specifications following were prepared by the Committee on Specifications for Sub-Grades and Foundations and were presented;

1. At the Convention held at St. Louis, Mo., in 1920, and printed in the Proceedings of that Convention on pp. 382–394;

2. At the Convention held at Baltimore, Md., in 1921, certain modifications of these specifications were recommended, which are printed in the Proceedings of that Convention on pp. 530–532.

3. At the Convention held at Cleveland, O., in 1922, the specifications printed in the 1920 Proceedings as modified by the changes recommended and printed in the 1921 Proceedings were again presented with the recommendation that they be adopted as Standard Specifications of the American Society for Municipal Improvements. This recommendation was adopted by the Convention in session on October 4, 1922, and the specifications were passed to letter ballot of the Society under the provisions of the Constitution. The result of the letter ballot is reported on page 402, and the following are the adopted specifications.

Broken Stone Foundations for Pavements

Sub-Grade: In the case of the construction of new broken-stone foundations for pavements the sub-grade shall be prepared by cutting or filling as may be required to produce a surface parallel with the finished grade of the wearing surface and a depth below the finished grade to the specified thickness of the foundation and paving material.

After rough grading has been completed, the surface of the sub-grade shall be brought to the required grade and cross-section and rolled with a power roller weighing not less than twelve (12) tons, until the surface thereof is unyielding. If required by the engineer, the sub-grade shall be drenched with water before rolling. Depressions or ruts occurring from any cause shall be brought to grade with good earth and thoroly rolled as above specified. Any portions of the sub-grade which are inaccessible to the roller shall be thoroly tamped with tampers weighing not less than forty (40) pounds, and having a face which shall not exceed eighty (80) square inches in area. All soft, spongy and unyielding spots and all perishable matter shall be entirely removed and the space filled with suitable matter.

Wherever clay, adobe, or soils of similar character are encountered, they shall be excavated to a depth of at least two (2) inches below the established grade of the sub-base. There shall then be provided a layer of coarse gravel, sharp sand, or other suitable material, which will afford proper drainage. This material will be brought to the established sub-grade and properly shaped and rolled.

Sub-Drainage: When in the opinion of the engineer the soil is of such a character that it retains an excessive amount of moisture, such as clay subject to swelling or heaving under the action of frost, or sands similar to quicksand that do not afford a ready natural drainage, sub-drains shall be provided and constructed as directed by the engineer.

New Macadam Foundation: After the sub-grade has been properly prepared, there shall be spread a layer of clean, broken trap rock or other suitable stone, which shall pass a 3-inch ring and be retained on a 2-inch ring, said stone to be spread in a uniform layer and shall have a depth, after final compression, of six (6) inches.

On this course of stone there shall be spread in uniform layers about one inch in thickness, screenings or sand, or a mixture thereof, acceptable to the engineer, which shall be swept into the interstices, and this operation shall continue until said interstices are completely filled. During the spreading of this binder the rolling shall continue until the foundation is thoroly filled and solidly compacted to the satisfaction of the engineer.

This binder shall not be applied in such quantity as to cover or form a coating over the top of the stone foundation. Any surplus binder which shall remain over the surface of this foundation shall be removed before the surface pavement or any second course of stone is laid.

Bank gravel or sand may be used for filling the interstices when same is approved by the engineer.

Old Macadam Foundation: The surface shall be thoroly swept and cleaned of all fine material that may be caked upon the surface of the stone or lying loose as dust, thereby exposing the clean coarse stone for the reception of the bituminous concrete.

If the old macadam does not present the desired coarse, grainy surface, or is not at proper and satisfactory grade after cleaning, it shall be spiked up and redressed to the desired crown and grade, the coarse stone being brought to the top by harrowing or otherwise, or new stone added when, in the opinion of the engineer in charge, it is needed to give the necessary thickness or character of surface. It shall then be thoroly rolled with the use of water as may be required.

In the case of bituminous pavements a layer about one stone deep of new, clean stone, averaging one and a half ($1\frac{1}{2}$) inches in size, shall be spread over the surface after redressing and rolling the old macadam, and finally rolled until firmly set in place without the application of water. This is intended to form a coarse, grainy surface of fresh clean stone which will bond with the bituminous paving material.

SPECIFICATION FOR ASPHALTIC BASE

(*Asphaltic Concrete Type*)

1. General Description: (a) The asphaltic base shall consist of a mineral aggregate composed of coarse aggregate and fine aggregate, uniformly mixed with asphalt cement and shall have a compacted thickness of .... inches.

(b) All materials and methods of construction shall conform to the requirements of these specifications.

2. Coarse Aggregate: (a) The coarse aggregate for asphaltic base mixture shall consist of broken stone, broken slag, mine tailings or gravel. It shall be of reasonably uniform quality and shall be free from dust and an excess of flat or elongated pieces. Rock or mine-tailings from which it is produced shall have a percent of wear of not more than five (5). Slag from which it is produced shall have a percent of wear of not more than ten (10) and shall for each commercial size used weigh not less than seventy (70) pounds per cubic foot. If gravel is used it shall be composed of sound, hard, durable pebbles, free from clay or coatings of any character.

(b) When tested by means of laboratory screens the coarse aggregate, which may consist of one or more commercial products, shall meet the following requirements:

Passing 2½-inch screen, not less than	95 percent
Passing 1¼-inch screen	25 to 75 percent
Passing ¼-inch screen	0 percent

Material which passes the ¼-inch screen in such commercial products shall in laboratory tests and for the purpose of proportioning the mixture be considered as fine aggregate.

3. Fine Aggregate: The fine aggregate for asphaltic base mixture shall consist of sand composed of clean, hard, durable grains, free from clay, loam and other foreign matter, together with particles which pass a ¼-inch laboratory screen which may be present in the coarse aggregate material. When tested by means of laboratory screens and sieves the sand or total fine aggregate shall meet the following requirements:

Passing	*Retained on*	*Percent*
Passing ¼-inch screen		100
Passing ¼-inch screen	10-mesh sieve	0 to 20
Passing 10-mesh sieve	40-mesh sieve	15 to 50
Passing 40-mesh sieve	80-mesh sieve	25 to 65
Passing 80-mesh sieve	200-mesh sieve	7 to 40
Passing 200-mesh sieve		0 to 6

4. Asphalt Cement: The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 175 deg. C. (347 deg. F.). It shall meet the following requirements for physical and chemical properties:

I. Specific gravity 25 deg./25 deg. C. (77 deg. /77deg. F.) not less than 1.000.
II. Flash point not less than 175 deg. C. (347 deg. F.).
III. Penetration at 25 deg. C. (77 deg. F.) 100 g., 5 sec., 40–70.

(Between these limits the exact penetration within a 10-point range shall be as directed by the engineer.)

IV. Ductility at 25 deg. C. (77 deg. F.) not less than 30.
V. Loss at 163 deg. C. (325 deg. F.) 5 hours, not more than 3 percent.

Penetration of residue at 25 deg. C. (77 deg. F.), 100 g., 5 sec., as percent of original penetration, not less than 50 percent.

VI. Percent of total bitumen soluble in carbon tetrachloride not less than 99 percent.

5. Sources of Supply: (a) Approval of sources of supply of coarse and fine aggregate under these specifications shall be obtained from the engineer prior to delivery of material and samples of each shall be submitted as directed by the engineer.

(b) A one-pound sample of the asphalt cement that the contractor proposes to use in his work, together with a statement as to its source and character, must be submitted with his bid. If the contractor proposes to prepare the asphalt cement at the paving plant, then in lieu of the above, a one-pound sample each of flux and refined asphalt must be submitted with his bid, together with a statement as to the source and character of each and proportions in which they will be combined to produce the asphalt cement which he proposes to use. No asphalt cement, flux, or refined asphalt, other than that specified in his bid, shall be used by any contractor except with the written consent of the engineer, and provided that the asphalt cement used shall comply in all respects with the requirements of these specifications.

6. Methods of Testing: Methods of testing shall be as follows:

(a) Per cent of wear of rock, mine tailings or slag; Standard Test D2–08, American Society for Testing Materials. When testing slag 4000 cc. loose measure of the size specified shall be used.

(b) Weight per cubic foot of broken slag; Tentative Standard Method C29–20T, American Society for Testing Materials.

(c) Screen test of coarse aggregate; Standard Method D18–16, American Society for Testing Materials.

(d) Sieve test of fine aggregate; Standard Method D7–18, American Society for Testing Materials.

(e) Physical and chemical properties of asphalt cement:

I. Specific Gravity, U. S. Dept. of Agriculture, Bulletin 314, p. 5.

II. Flash Point (open cup) U. S. Dept. of Agriculture, Bulletin 314, p. 17.
III. Penetration, A. S. T. M. Standard Test D5–16.
IV. Ductility, Trans. A. S. C. E. Vol. LXXXII, 1918, p. 1460.
V. Volatilization Test, U. S. Dept. of Agriculture, Bulletin 314, p. 19, using 50-gram sample.
VI. Bitumen soluble in carbon tetrachloride, U. S. Department of Agriculture, Bulletin, 314, p. 30.

Preparation and Composition of Mixture

7. Preparation of Asphalt Cement: (a) The asphalt cement shall be melted in kettles designed to secure uniform heating of the entire contents and shall be brought to a temperature of 250 deg. F. to 350 deg. F.

(b) When refined asphalt is to be combined with a flux the mixture shall be thoroly agitated until a homogeneous asphalt cement of the required penetration is produced. The penetration of the asphalt cement shall be tested at suitable intervals to insure that it is maintained at a uniform consistency thruout the period of use.

8. Preparation of Mineral Aggregate: (a) The coarse and fine aggregates for asphaltic base mixture shall be dried and heated at the paving plant in suitably designed revolving driers. They shall be heated to a temperature of 225 deg. F. to 350 deg. F., as determined on the mixing platform. The aggregates may be simultaneously fed into the same drier but in such case they shall immediately after heating be screened into coarse and fine aggregate and stored in separate bins, except in plants where the aggregates are proportioned and dried by the batch method.

(b) A registering pyrometer shall be installed at a suitable point at the discharge end of the drier, with the registering device so located as to clearly indicate to the drum firemen the temperature of the mineral aggregate when discharged.

9. Preparation and Composition of Asphaltic Base Mixture: (a) The coarse and fine aggregate for asphaltic base mixture shall be measured separately and accurately either by weight or volume for each batch to be mixed. The required quantity of hot asphalt cement for each batch shall be measured by actual weighing with scales attached to the asphalt-cement bucket. The mixture shall be made in an approved twin pug or batch mixer by first charging it with the coarse aggregate. After these have been thoroly mixed the asphalt cement shall be added and the mixing continued for a period of at least forty-five (45) seconds or longer if necessary to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated.

(b) The constituents of the asphaltic base mixture shall be combined in such proportions as to produce a mixture conforming to the following composition limits by weight:

Passing 2½-inch, retained on 1-inch screen	15 to 45 percent
Passing 1¼-inch, retained on ¼-inch screen	15 to 45 percent
Total of the above two grades	53 to 70 percent
Passing ¼-inch screen	25 to 40 percent
Bitumen (asphalt cement soluble in carbon disulphide)	4 to 7 percent

10. Paving Plant Inspection: For the verification of weights or proportions and character of materials, and determination of temperatures used in the preparation of the mixture the engineer or his authorized representatives shall have access at any time to all parts of the paving plant.

11. Transportation of Mixture: The asphaltic base mixture shall be transported from the paving plant to the work in tight vehicles previously cleaned of all foreign materials and when directed by the engineer each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions. No loads shall be sent out so late in the day as to interfere with spreading and compacting the mixture during the daylight unless artificial light satisfactory to the engineer is provided.

12. Placing Asphaltic Base Mixture: Prior to the arrival of the asphaltic base mixture on the work the prepared sub-grade or underlying course shall be cleaned of all loose and foreign materials. The mixture shall be delivered at a temperature of 225 deg. F. to 325 deg. F. It shall be laid only when the prepared sub-grade or underlying course is dry or at least free from standing water and only when weather conditions are suitable. Upon arrival on the work it shall be dumped outside of the area on which it is to be spread and shall then be immediately distributed into place by means of hot shovels and spread with hot rakes in a uniformly loose layer to correct depth. No more asphaltic base shall be placed in advance of laying the surface course than can be covered by one day's run of the paving plant on surface mixture.

13. Compacting Mixture: While still hot the asphaltic base mixture shall be thoroly and uniformly compressed by a power-driven roller weighing not less than ten (10) tons except that a tandem roller weighing not less than eight (8) tons may be used if approved by the engineer. Rolling shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least one-half the width of the roller, until all roller marks are eliminated. The motion of the roller shall at all times be slow enough to avoid displacement of the hot mixture and any displacement shall at once be corrected by the use of rakes and of fresh mixture where required. Rolling shall proceed at an average rate not to exceed two hundred (200) square yards per hour per roller, and shall continue until no further compression is possible. To prevent adhesion of the asphaltic base mixture to the roller, the wheels shall be kept properly moistened, but excess of either water or oil will not be permitted.

(b) Along curbs, headers and similar structures and at all places not accessible to the roller the mixture shall be thoroly compacted with hot tampers.

(c) The surface of the mixture after compression shall be smooth and true to the established crown and grade. Any mixture which becomes loose or broken, mixed with dirt, or in any way defective prior to laying the surface course, shall be removed and replaced with fresh hot asphaltic-base mixture, which shall be immediately compacted to conform with the surrounding area.

14. Joints: Placing of the asphaltic base shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the base is to be discontinued for such length of time as to permit the mixture to become chilled. In all such cases, including the formation of joints as hereinafter specified, provision shall be made for the proper bond with new surface mixture by cutting or trimming back the joint so as to expose an unsealed or granular surface for the full specified depth of the course. At the end of each day's work on base mixture, joints shall be formed by laying and rolling against boards of the thickness of the compacted mixture, placed across the entire width of the pavement, or by such other method as may be approved by the engineer. When the laying of the asphaltic base is resumed the exposed edge of the joint shall be painted with a thin coat of hot asphalt cement or asphalt cement thinned with naphtha, and the fresh mixture shall be raked against the joint, thoroly tamped with hot tampers, and rolled.

15. Protection of Asphaltic Base: If at the time of laying asphaltic-base mixture side supports such as curbs, edgings, gutters or shoulders have not been constructed, planks of suitable thickness shall be laid along each side of the pavement so as to prevent the mixture from squeezing out under the roller. These planks shall remain in place until final compaction has been obtained. Sections of compacted mixture shall be kept clean and as free from traffic as possible prior to laying the surface course.

16. Conditions Prior to Laying Surface Course: Immediately before laying surface course the base shall be cleaned of all dirt or other foreign material so as to present a uniformly rough or granular appearance admitting of complete bond with the wearing course. It shall preferably be warm when the surface course is placed.

SPECIFICATION FOR TAR-BOUND BASE, HOT PENETRATION TYPE

Drainage: The road bed shall be perfectly drained. Side-drains, cross-drains, and V-drains shall be provided as shown on engineer's plan, where required by local conditions.

Roller: The roller used shall be a power roller of a type suitable for macadam road construction and shall weigh 10 to 15 tons.

Sub-Grade: In the case of the construction of new broken-stone foundations for pavements the sub-grade shall be prepared by cutting or filling as may be required to produce a surface parallel with the finished grade of the wearing surface and a depth below the finished grade equal to the specified thickness of the foundation and paving material.

Stone: The stone shall be of best quality crushed rock (or other approved road metal) free from dust, loam or clay.

Base Course: The lower course shall consist of crushed stone which shall pass a three and one-half ($3\frac{1}{2}$)-inch ring and be retained on a two and one-quarter ($2\frac{1}{4}$)-inch ring, spread to a finished depth of .... inches, but .... inches below the finished grade. The course shall be filled thoroly with clean sand, gravel, stone screenings or similar filler approved by the engineer, and rolled until smooth and firm. No filler shall be left on the surface.

Waterproofing Course: The waterproofing course shall be placed on the base and shall consist of a layer of crushed stone which shall pass a two and one-quarter ($2\frac{1}{4}$)-inch ring and be retained on a one and one-quarter ($1\frac{1}{4}$)-inch ring, spread to a finished depth of not less than two and one-half ($2\frac{1}{2}$)-inches. (See Note.) This course shall not be filled but shall be keyed thoroly together by rolling. The surface shall be left smooth and of even texture, clean and free from dirt, clay, stone dust or other material which will prevent the easy penetration of the refined tar.

First Coat of Refined Tar: Refined tar, as hereinafter specified, heated to a temperature of not less than 200 deg. F., and not more than 275 deg. F., shall be spread uniformly over the surface when dry to the amount of not less than one and seven-tenths ($1\frac{7}{10}$) gallons, nor more than one and eight-tenths ($1\frac{8}{10}$) gallons to the square yard.

Three-Quarter-Inch Stone: Three-quarter ($\frac{3}{4}$)-inch crushed stone without dust, i.e., stone which shall pass a one and one-quarter ($1\frac{1}{4}$)-inch ring and be retained on a one-half ($\frac{1}{2}$)-inch ring, shall be spread over the surface, filling the voids but leaving none on the surface. This course shall then be rolled until firm. The road shall be swept free from any particles of stone not held by the refined tar.

If the wearing course is to be a block pavement, a sand-tar cushion, as hereinafter specified, shall be laid over the base as completed in the above section.

If the wearing course is to be sheet asphalt or bituminous concrete the water proofing course shall be finished as follows:

Second Coat of Refined Tar: Not less than one-half ($\frac{1}{2}$) nor more than three-quarters ($\frac{3}{4}$) of a gallon of refined tar to the square yard, heated to a temperature of not less than 200 deg. F., nor more than 275 deg. F. shall be spread over the surface of the waterproofing course, and covered with stone screenings or sharp sand. The road shall then be rolled until compacted. All loose screenings or sand shall be swept off, and the wearing course shall be laid directly on the completed waterproofing course.

Sand-Tar Cushion: Upon the completed foundation course shall be spread a course $\frac{3}{4}$-inch thick, of sand, mixed with refined tar for surface treatments (see A. S. M. I. Specifications 1918, p. 365), in the proportion of 90 per cent sand and 10 per cent refined tar, by volume. The sand shall be clean and dry and shall be mixed with the refined tar until a uniform, homogeneous mixture is obtained. It shall then be spread on the foundation course, and shaped to a true surface parallel to the surface of the finished pavement.

NOTE: This size stone is best for trap rock or hard rock which does not break under the roller. If limestone or other soft rock is used, a larger size stone may be used to advantage.

(1) Refined Tar "G," A. S. M. I. Proceedings, 1915, p. 437: The refined tar shall be homogeneous, free from water and shall not foam when heated to 150 deg. C. (302 deg. F.).

(2) Its specific gravity at a temperature of 25 deg. C. (77 deg. F.) shall be not less than 1.200 nor more than 1.300.

(3) When tested by means of the New York Testing Laboratory float apparatus, the float shall not sink in water maintained at 50 deg. C. (122 deg. F.) in less than 140 seconds nor more than 170 seconds.

(4) Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall not be less than 75.0 percent nor more than 90.0 percent, and it shall not show more than 0.2 percent ash upon ignition of the material soluble in carbon disulphide.

(5) When distilled according to the tentative method recommended by Committee D-4 of the American Society for Testing

Materials in 1911, it shall yield no distillate at a temperature lower than 170 deg. C. (338 deg. F.); not more than 10.0 percent by weight shall distil below 270 deg. C. (518 deg. F.) and not more than 20.0 percent by weight shall distil below 300 deg. C. (572 deg. F.).

(6) The total distillate from the test made in accordance with clause (5) shall have a specific gravity at a temperature of 25 deg. C. (77 deg. F.) of not less than 1.030.

(7) The melting point, as determined in water by the cube method, of the pitch residue remaining after distillation to 300 deg. C. (572 deg. F.) in accordance with the test described in clause (5), shall not be more than 75 deg. C. (167 deg. F.)

Refined Tar for Sand Tar Cushion: The refined tar for cushion shall conform to the requirements for "Refined Tar for Surface Treatments," A. S. M. I. Specifications for 1918, page 365 of the Proceedings for 1918.

Its specific gravity at 25 deg. /25 deg. C. (77 deg. /77 deg. F.) shall not be less than 1.100 nor more than 1.180.

When tested by means of the Engler viscosimeter at 40 deg. C. (104 deg. F.) the specific viscosity of the first 50 cubic centimeters passing the orifice of the viscosimeter shall be not less than 10 nor more than 35, with a maximum range not exceeding 5.

NOTE: Low specific viscosities should be used for work in the northern states and high specific viscosities for work in the southern states.

Its bitumen, as determined by its solubility in chemically pure carbon disulphide at room temperature, shall be not less than 90 percent.

When distilled according to the American Society for Testing Materials Standard Method, it shall yield not more than 5 percent of distillate at a temperature lower than 170 deg. C. (338 deg. F.); not more than 30 percent shall distil below 270 deg. C. (518 deg. F.); and not more than 40 percent shall distil below 300 deg. C. (572 deg. F.).

SPECIFICATION FOR TAR-BOUND BASE, COLD PENETRATION TYPE

Drainage: The road bed shall be perfectly drained. Side drains, cross drains and V-drains shall be provided as shown on engineer's plan, where required by local conditions.

Roller: The roller used shall be a power roller of a type suitable for macadam roads construction and shall weigh ten to fifteen tons.

Sub-Grade: In the case of the construction of new broken-stone foundations for pavements the subgrade shall be prepared by cutting or filling as may be required to produce a surface parallel with the finished grade of the wearing surface and a depth below the finished grade equal to the specified thickness of the foundation and paving material.

Stone: The stone shall be of best quality crushed rock (or other approved road metal) free from dust, loam or clay.

Base Course: The lower course shall be crushed stone which will pass a 3½-inch ring and be retained on a 2½-inch ring, spread to a finished depth of ... inches, but .... inches below the finished grade. The course shall be filled thoroly with sharp sand, gravel, stone or slag screenings or similar filler approved by the engineer and rolled until smooth and firm. No filler shall be left on the surface.

If a deep foundation course is necessary, the stone shall be laid and rolled in separate layers not over 4 inches in thickness. When local conditions require, Telford may be substituted for part of the broken stone foundation.

Waterproofing Course: The waterproofing course shall be placed over the base thus prepared and consist of a layer of stone which will pass a 2¼-inch ring, and be retained on a 1¼-inch ring, spread to a finished depth of not over 3 inches. This stone shall be rolled dry until it is thoroly locked together and shows no movement under the roller and shall be even and true to the lines, grades and cross-sections.

Filling Waterproofing Course: The filler shall be broken stone or broken slag screenings, or sand, and be rolled into the stone by spreading in light even applications over the surface, keeping the roller passing back and forth and adding more filler as it rattles into the voids, and continuing these operations until the filler is flush with the surface of the stone; to be done without water. When the voids are filled, water shall be used and more filler added as needed to bring it flush with the surface of the stone. If sand is used for the filler, slag or stone screenings may be used with the water to finish up. Sufficient filler and water to form the usual grout or to cover the stone shall not be used. Traffic shall be kept off the road while it is drying out and any excess of filler on the surface shall be swept off, so that the stone shall be exposed.

Applying Refined Tar: When the road is dry, one gallon of refined tar, as hereinafter specified, per square yard, or more if the road will absorb it, shall be applied in two or more uniform applications. Each application shall be allowed to penetrate until there is no excess bitumen on the surface of the road before making additional application.

Covering and Rolling: The covering material shall be either clean, dry sand, or granulated slag. The covering shall be spread within two to four hours after the last application of refined tar, and sufficient used to prevent the roller from picking up the binder. The foundation shall then be thoroly rolled. At the conclusion of the rolling the refined tar shall just show thru the cover.

If the wearing course is to be sheet asphalt, it shall be laid on this surface. If the wearing course is to be a block pavement, it shall be laid on a sand-tar cushion.

Sand-Tar Cushion: Upon the completed foundation course shall be spread a course $\frac{3}{4}$ inch thick of sand, mixed with refined tar as hereinafter specified, in the proportion of 90 percent sand and 10 percent refined tar, by volume. The same shall be clean and dry and shall be mixed with the refined tar until a uniform, homogeneous mixture is obtained. It shall then be spread on the base course and shaped to a true surface parallel to the surface of the finished pavement.

Refined Tar for Base and Cushion: The refined tar for base and cushion shall conform to the requirements for "Refined Tar for Surface Treatments," A. S. M. I. Specifications for 1918, page 365 of the Proceedings for 1918.

Its specific gravity at 25 deg. /25 deg. C. (77 deg. /77 deg. F.) shall not be less than 1.100 nor more than 1.180.

When tested by means of the Engler Viscosimeter at 40 deg. C. (104 Deg. F.) the specific viscosity of the first 50 cc. passing the orifice of the viscosimeter shall be not less than 10 nor more than 35 with a maximum range not exceeding 5.

NOTE: Low specific viscosities should be used for work in the northern states and high specific viscosities for work in the southern states.

Its bitumen, as determined by its solubility in chemically pure carbon disulphide at room temperature shall not be less than 90 percent.

When distilled according to the American Society for Testing Materials Standard Method, it shall yield not more than 5 percent of distillate at a temperature lower than 170 deg. C. (338 deg. F.); not more than 30 percent shall distil below 270 deg. C. (518 deg. F.); and not more than 40 percent shall distil below 300 deg. C. (572 deg. F.).

REPORT OF CANVASSING COMMITTEE OF VOTES ON CONSTITUTIONAL AMENDMENTS AND ADOPTION OF SPECIFICATIONS

February 2, 1923.

Mr. W. W. Horner,
300 City Hall,
St. Louis, Mo.

Dear Sir:

Your committee appointed to canvass the ballots cast by the members on the constitutional amendments and specifications in the letter ballot, ordered by the Convention held at Cleveland, Oct. 2–6, report as follows;

The number of votes cast was 36. Votes on the amendments were as follows;

Article II, 34 for, 2 blank.
Article IV, 36 for.
Article VI, Sec 6, 34 for, 2 blank.
Article VI, Sec. 8, 34 for, 2 blank.

Votes on the specifications for Sub-Grade and Foundations for pavements were as follows:

Fifteen (15) votes for the specifications as a whole.

One for all of the specifications with two exceptions, namely, (a) New macadam foundations, first paragraph, last line, limited depth of 6 inches. No. (b) Asphalt concrete type, fourth paragraph. Asphalt cement II. Flash point 175 deg. C (347 deg. F.) No. (The adopted asphalt specifications read 350 deg. F.)

Respectfully submitted,

Chas. C. Brown, *Chairman,*
E. C. Garvin,
J. W. Turner,
Committee.

BUSINESS PROCEEDINGS OF THE TWENTY-EIGHTH ANNUAL CONVENTION

TUESDAY MORNING, OCTOBER 3, 1922

The Twenty-eighth Annual Convention of the American Society for Municipal Improvements convened at ten o'clock at Hotel Hollenden, Cleveland, Ohio, President E. S. Rankin presiding.

PRESIDENT RANKIN: In calling this, the Twenty-eighth Annual Convention to order, it may be of some interest to note that we are meeting this morning for the third time within the State of Ohio. The second Convention of the Society, in 1895, was held in Cincinnati, which at that time ranked as the largest city in the State. Twenty years later we met in Dayton, and, incidentally, the President that year was another son of New Jersey, Mr. William A. Howell, and this morning for the third time we are meeting in this State and for the second time in its largest City, for during these twenty-seven years, Cleveland has far outstripped her sister city of Cincinnati.

I regret very much to announce that owing to a previous engagement, His Honor, Mayor Kohler, will not be able to be with us, but he has deputized Mr. Miller of the Law Department who will officially welcome us to Cleveland.

RAY MILLER: Mr. Chairman, and Gentlemen: In the absence of Mayor Kohler and because of his inability to attend and be present at your convention, I am here in his place and stead to welcome you to the city of Cleveland. The Mayor desires me to say to you that the city of Cleveland welcomes many conventions within the limits of our municipality, but seldom do we welcome a convention whose aims redound so much to the benefit of our community as this convention.

You come to this convention with a full knowledge of all the arts and the last word in engineering as used in your different municipalities. You then, as it were, resolve your convention into an exchange wherein you furnish your professional brothers with your observations, your experience and counsel and receive the ideas and schemes as carried on by engineers of other municipalities. Upon your conclusions we become a better municipality. We have better roadways, better sewer and garbage disposal systems, safer engineering, and we become a better community. As there can be no change in the existing conditions of a municipality, no alterations or improvements without engineering counsel, so you constitute the very pulse of a municipality.

You tell us when our roadways are unsafe, when our bridges and buildings are unsafe, and you then build safe avenues and bridges. You therefore contribute greatly to the safety of our citizens.

You are here to exchange your professional ideas, to learn from the experience of others, and then you go back to your communities with this acquisition and therefore promote the welfare of your own communities and contribute to their comfort and happiness, and protect the safety of the life and limb of citizens.

Therefore, the citizens of Cleveland welcome you and wish you success in your deliberations and consultations.

President Rankin: In accordance with our regular custom I will ask our First Vice-President, Mr. Horner, to respond to the Address of Welcome.

W. W. Horner: Mr. President and Mr. Miller: As you know it is customary for the city's engineers and the municipal executives, together with their technical and commercial advisers from all parts of the country to meet together once a year. These servants of the people enjoy this opportunity of getting out from under the master's thumb, and they enjoy the chance to meet together and compare notes in the corners of the hotel lobby. These meetings too have their formal side, when we stand before the fraternity and read into the record the experiences of the year—sometimes of disappointments with their lessons, but in general, records of real achievement and progress. Then, too, we enjoy listening to the siren call of the manufacturer, who has found, and sometimes patented, the long, sought, ideal paving material.

But of all the phases of these meetings, the most enjoyable is that which uses the convention city as a laboratory, and an exhibit.

Much more can be appreciated of municipal management and of public works when inspected and explained by those responsible, than can be learned from the best written dissertations. We are, therefore, careful in our choice of a meeting place. The convention city must be of sufficient size to have enjoyed the advantages of wide-spread organizations and to have included within its problems those things which we are interested in studying. It must not have reached that obese state which reduces some of the city's problems to peculiarities. Therefore, last year, at Baltimore, we were very much pleased at the kind invitations that came to us from the city of Cleveland.

We have heard much of your city. We know of its industrial expansion. Our proceedings are filled with its municipal affairs. We know of the sound growth, which in a comparatively short period of years has permitted it to emerge from the dreaded class of middle class cities to the very comfortable dimensions of my home town. Under your kind guidance we expect to see the city of Cleveland in all its variety from its municipal golf links to its sewage disposal works.

We have appreciated the invitations which came to us, and we have appreciated the very cordial welcome which we have received. On behalf of the Society, I thank you for that welcome.

President Rankin: All of you who live in cities which have held conventions know and most of you, I think, will realize that these things don't simply happen. There is a lot of work connected with it, and I am going to call now on the man behind the gun, the Chairman of our Convention Committee, Mr. Robert Hoffman.

Mr. Hoffman: There is not much that I can tell you as representing our local committee, except this, that we are extremely gratified at the large registration which has been shown up to the present time, and at the apparent good attendance which the convention is to have. A good attendance is after all what repays any local committee for the work which it may be called upon to do in anticipation and in preparation of a convention such as this. We have endeavored in the best way that we could to anticipate the wants of the convention. We may have overlooked some things and would therefore be pleased to receive any suggestions, if such has been the case. If some one will tell us of anything we have overlooked, or any arrangements that should be made, we will do our best to meet their wants.

I might say at this time that Cleveland offers the usual line of improvements and undertakings such as are customarily found in the large cities of the country. I do not need to enumerate them, but we have done work and made progress in connection with water development, sewage disposal, and the ordinary construction work such as pavements and sewers. In case any of our delegates are interested in seeing any part of this construction, if they will leave their names at the registration desk, we will endeavor to arrange an inspection at their convenience, at such time as they may be able to spare from the meetings.

I would also like to call your attention to the announcements which have appeared in our daily news sheet referring to the desirability of registering as early as possible in connection with the dinner, the automobile trip, and the excursion to Nela Park. The dinner takes place on Wednesday, and the automobile trip and excursion to Nela Park on Thursday. It will be extremely helpful to the committee if this registration can take place as early as possible, so that the committee may find out just how many to provide for.

I desire also to announce that the Pullman Company will have a representative on hand today who will be glad to make such reservations as the delegates may care to make at this time.

I want to express my gratification Mr. President, for the good attendance on the part of the delegates, and trust that you may enjoy your stay in Cleveland.

President Rankin: As you know, gentlemen, there is meeting here today, another Society, whose work lies along parallel lines with our own, or possibly I had better say, intertwining lines, and we have with us the President of the Ohio State Conference on City Planning, Mr. Alfred Bettman, who has kindly consented to say a few words to us.

Alfred Bettman: It is certainly a source of great gratification to those of us who have been thinking on this problem of city planning to find that these two associations, meeting at the same time in the city of Cleveland with allied programs, are de-voting one whole evening of your valuable time to the subject of city planning: This gives us a realization that we are working simply in two subdivisions of the same problems; and those are the problem of making more comfortable, more happy, and more helpful, the lives of the rapidly increasing number of human beings that are gathering in our great urban communities; and that the problem of building the street can not be intelligently solved as a single problem in and of itself, but that it is but a part of the general problem of what the street is for, from where to where it shall go, and what shall be its contribution to the comfort and convenience of the community which it serves.

Now city planning simply bears somewhat the same relation to your work that the architect's work bears to him who builds the house, and in a way precedes it; and yet the examination of the city planner's ideas or dreams lies in the hands of those who actually do the construction, so that we are but parts of the same problem. I wish again to express my great pleasure in the symbolic fact that this joint program of Cleveland and our meeting here jointly shows our realization that we are parts of the same problem.

I understand you are going to devote your whole session this evening to this subject, and that you have invited the members of our Conference to this evening's session and we are going to take advantage of your hospitality. I thank you.

PRESIDENT'S ADDRESS

Edward S. Rankin, Newark, N. J.

After this auspicious beginning of our meeting, this pleasant exchange of amenities between the Convention City as represented by Mr. Miller, and our Society through its First Vice-President, Mr. Horner, the greetings from our sister society, and the words of Mr. Hoffman or as we might think of them—the paternal blessing, the fraternal feeling and the filial report, it becomes my privilege and my duty in accordance with the provisions of the Constitution to open the more formal business of the Convention with the President's address.

I wish to add my personal thanks to Mr. Miller for the courtesies extended to us and to extend to him, to Mayor Kohler and to all other city officials a cordial invitation to attend any or all of our sessions. We will be delighted to have them present and we believe that their time will not be wasted, for this is not entirely an engineering or technical society.

Some years ago, at the Atlantic City Convention in 1908 and again in Little Rock in 1909 to be exact, the proposition, was made to change the name of our organization from the "American Society of Municipal Improvements" to the "American Society of Municipal Engineers." The argument for the change was that altho the Society in its inception and for some years thereafter devoted itself to the more general aspects of municipal problems, it had gradually but steadily become more technical in its work until papers and discussions on strictly engineering subjects had practically crowded out all other topics, with a corresponding increase in the proportion of engineers in its membership. The proposed change was not approved on the ground that while engineers did make up the bulk of the membership, and while the papers presented were mainly along engineering lines, we did have among our members a substantial percentage from other branches of city government and that it was a distinct advantage not only to the Society as a whole, but to the individual engineering members as well, to encourage these other officials to join the Society, to attend the Conventions and to take part in the proceedings. To quote from some remarks made at the Little Rock meeting by one of our Past Presidents: "I believe the greatest advantage that can be derived from this Society would be derived if the municipal engineers would only get the members of their Boards of Public Works and Councilmen to come to these conventions. That is to my mind more productive of good results in bringing about municipal development than to confine ourselves to the mere technical phases of these engineering questions, because you and I have opportunity to study municipal questions,—we present these things to our commissioners or boards, and we present them so often that they get tired of hearing us and they begin to say we are cranks. If we can get our Commissioners to come here and see that the fellow from X and the fellow from Y and the fellow from Z are all harping on the same thing, he would go back home and say 'I dont know but that fellow is right. All these other cities are going thru it.'" These remarks are as true today as they were in 1909. We want our Executive officers with us. We want them to see at first hand the real constructive work that this Society is attempting and what it is actually accomplishing. We want them to get better acquainted with us.

The old story is still too painfully true that is told of the Council Meeting where it was proposed by one member to engage a City Engineer at a salary of $150 a month, only to be opposed by another member with the remark "why Mr. President we can get plenty of good engineers for $75.00 a month and for $100 a month we can get a locomotive engineer." As I said, the story is old and the figures on a pre-war basis, but the point still holds. My own city is fortunate in having for its Director of Public Works a man who recognizes the distinction between a profession and a trade, but far too few of our executive officers realize the qualifications necessary to successfully solve engineering problems, the responsibility resting on their engineers or what would constitute a suitable compensation therefore.

But it is not alone the question of salaries that is affected; the close association between the engineers and the elected officials, meeting under a different environment, the way in which among themselves they handle these municipal problems, cannot fail to raise the former, even though perhaps unconsciously, to a higher plane in the minds of the latter, possibly even approaching those dizzy heights occupied by the accounting and the legal departments. By all means we want our Mayors and our Commissioners with us.

In this same connection may I speak for a few minutes of two other elements which enter into the construction of nearly all of our public works, the contractors and material men, those who make up our Associate Membership? I am aware that here I am treading on rather dangerous ground and possibly you will not all agree with me but I consider it unfortunate that we have not among these Associate Members more contractors, the men who actually do the work of building our sewers and paving our streets as distinct from the men who furnish the materials with which the work is done.

I believe the day has gone by when the engineer and the contractor looked upon each other as natural enemies; when the engineer felt that he was doing his city a service if the contractor lost money on the job and when the contractor considered it perfectly legitimate and a recognized part of the game if he could put something over on the engineer. We are getting closer together and learning that we can be mutually helpful.

Yes, I think we want the contractors with us. We want to know each other better and learn the other fellow's point of view. Many engineers, especially the younger men, would profit by the contractor's more practical methods, and many contractors by a little more respect for the engineer's theories.

And then finally we want the material men, the manufacturers, with us. These men have proved that if they can only find out just what we want they stand ready to furnish it if it is within the range of possibility to do so. Possibly no better example can be cited than the transformation of our granite block pavements from the rough, noisy pavement of only a few years ago to the smooth almost noiseless pavement of today. A simple case of co-operation between the engineer, contractor and quarry owner. The elimination of the endless varieties and sizes of paving brick recently accomplished thru the efforts of the Department of Commerce at Washington and in which our Society took part, is another example of what can be done by all getting together.

What we need is co-operation. Co-operation between the executive and the engineer and between the engineer and those who carry out the work, and it is in such societies as this, in such meetings as this, that this co-operation can best be obtained. And it is not alone in this convention hall that we derive the benefit from these meetings, not alone from the papers presented, valuable though they are, or from the discussions which follow, interesting though they may be. If this were all most of us could as well stay at home and read at our leisure the Proceedings when they are published. The entertainment features for which we are indebted to the Committee on Convention Arrangements are not simply occasions for enjoying ourselves. I believe they have a distinct value from the educational side. On these rides and inspections and at the more social gatherings we become better acquainted with our fellow members, whether engineers, executives or associates and find here a better opportunity to discuss those more personal problems of not sufficient general interest to present to the Society as a whole, but of great interest to us as individual members. And so it is all thru the Convention; at the exhibit tables, in the corridors of the hotel and in the dining rooms. Even in the private rooms of the delegates where a few choice spirits meet from time to time we find the same thing, although it must be admitted that the matters here discussed deal largely with certain problems in irrigation or with the subject of interior decoration.

I have sometimes heard our Society pin criticised as being nothing more than a conventional design with no particular significance attaching to it, but it seems to me that the designers of that pin had a rare vision of what this Society should stand for; that the four pointed star inclosed within a circle is something more than a mere convenient device on which to engrave the four letters "A.S.M.I."; and that the four points of the star represent the four elements of which our membership is composed, first, The executives on whom rests the responsibility of determining the policy to be pursued before any improvements can be made, and the raising of funds to carry out this policy; second, the engineers who design and superintend the work in accordance with the program determined upon by the executives; third, the contractors who execute the work under the direction of the engineers; and fourth, the manufacturers who furnish the materials used by the contractors; all four embraced within the circle representing the Society.

There are perhaps no two words in the English language which have been so overworked for the past few years as the words "efficiency" and "co-operation." I do not intend to speak at this time on the former but the title of this address might be "The Spirit of Co-operation" and the point I wish to make is that only by co-operation between these four classes of our members can the best results be achieved. But it is not enough merely to state the point and let it go at that.

I am reminded of the story of the school boy who was told by his teacher to write a composition on the subject "Why won't a pin stand on its point." The next morning he came in with something like this: "There are three reasons why a pin won't stand on its point. First, my geometry says a point is something that has neither length, breadth or thickness, and a pin can't stand on that. Second, a pin will not stand on its head, much less therefore on its point. Third, it will if you stick it in." And, gentlemen, we have got to stick it in, and sometimes it takes a lot of hammering to make it stick.

I can conceive of no higher aim for this Society than the fostering and encouraging of this spirit of co-operation between these four elements having to do with the physical improvement of our cities. With this co-operation assured the cities of America will continue to grow not only in size, but in beauty and attractiveness and in all things that make for the health, the comfort and the prosperity of their citizens; and this Society, composed of these four elements all working together toward one common end will be in deed as well as in name a Society for Municipal Improvements.

REPORT OF THE EXECUTIVE COMMITTEE

The report of the Executive Committee is usually confined to the proceedings of its meeting immediately preceding the Convention. As the secretary's report was not complete owing to the non arrival of the treasurer's report, the Secretary was instructed to complete the former and print it in revised form. It follows this report.

There were thirty-nine candidates for membership, thirty-three of whom are active, five, associate, and one affiliate. Thirty-five names were considered with respect to dropping from the rolls on account of dues not having been paid, and it was ordered that they be dropped if they did not pay.

Invitations were received from Louisville, Montreal, Atlanta and Providence, for the next Convention and were referred to the Committee on Place of Meeting, when appointed. Several reclassifications of members were made on account of change of occupation, which would change their status in the membership list.

Our delegate, Mr. Compton, to the American Construction Council, made a detailed report, which will be presented to the Convention on Friday morning at the time set for such reports.

The appointments of delegates to the Council for next year were referred to the new President.

Two amendments to the Constitution were proposed, one of which was the result of a communication which the President sent to the members of the Executive Committee during the year, and they were referred to special committees, and both of them have resulted in proposed amendments to the Constitution, which will be presented by Mr. Tillson this morning.

One of these referred to membership of engineers of Public Service Corporations, or rather the inclusion of such members in the active list, and the other to a revision of the Committee list, which is intended to reduce the number of Committees and number of members in the Committees, as will be shown by the amendment when it is presented.

REPORT OF THE SECRETARY

Charles Carroll Brown, St. Petersburg, Fla.

The Secretary presents his report for eleven months ending September, 1922.

The following table gives the record of changes in membership for the eleven months beginning October 1, 1921, and ending September 1, 1922.

CLASS	MEMBERSHIP SEPTEMBER 30, 1921	ADMITTED DURING YEAR	LOST DURING YEAR	MEMBERSHIP AUGUST 31, 1922
Active	483	61	44	500
Affiliated	35	12	15	32
Associate	130	18	17	131
Total	648	91	76	663

Following are the changes in personnel since the publication of the lists on pages 439, 441 and 643 of the Proceedings for 1921.

Additions

Active

Jesse K. Giesey	New York City
J. P. Jervey	Portsmouth, Va.
F. A. Marston	Boston, Mass.
E. B. Robertson	Stevens Point, Wis.

Affiliated

E. L. Flannigan	Baltimore, Md.

Associate

Imperial Oil Co., F. A. Hogan, Rep.	Toronto, Ont.
Westinghouse Electric and Manufacturing Co., L. A. S. Wood, Rep.	South Bend, Ind.

Losses

Deceased

Walter L. Hull, *Active*.................................Orange, N. J.

Muncipal Delegates not Reappointed

J. D. Fitzgerald, *Active*............................Sydney, Australia

Representatives of Associate Members not Reappointed

John M. Bailey.......................................Pittsburg, Pa.
S. M. Christhilf.....................................Baltimore, Md.

Resigned

Jennison Wright Co., H. J. Jennison, Rep. *Associate*........Toledo, Ohio

Mail Returned Undelivered

W. L. Gay, *Affiliated*..............................Chattanooga, Tenn.

Dropped

Constantine Construction Co., J. S. Constantine, Rep.
Associate..Buffalo, N. Y.
Frank T. Fay, *Associate*................................Boston, Mass.

The following table shows the monthly receipts during the year, classified as to source, and the remittances to the Treasurer.

MONTH	MEMBERSHIP DUES			PROCEEDINGS SOLD	SPECIFICATIONS SOLD	ADVERTISEMENTS	MISCELLANEOUS	REMITTED TO TREASURER	
	Active	Affiliated	Associate						
1921									
Oct.–Nov....	$1155.00	$60.00	$377.50	$30.00	$0.50	$ 8.00	$0.82	$1631.82	12/1/21
1922									
Dec.–Jan.	239.50	15.00		12.25	0.25	40.00	1.00	308.00	2/1/21
Feb.–Mar.–April..	525.50	80.00	557.50	43.50	1.75	86.00		1294.25	5/1/21
May–June...	305.50	7.50	105.00	41.80	5.75			465.55	8/1/22
July–Aug....	50.00		30.00	17.00		289.81		386.81	9/1/22
Totals.	2275.50	162.50	1070.00	144.55	8.25	423.81	1.82	4086.43	

The amount in the treasury transferred to Treasurer White at the beginning of the year was $184.55, as shown by his report. He received during the year from interest on Liberty bonds $63.75, making the total receipts for the year $4334.73.

Following is an approximation which is sufficient to show the general tendency of the year's business.

Office and Miscellaneous:		
Printing and Stationery	$142.37	
Telegrams and Exchange	13.90	
Postage, Express & Freight	216.94	
Office Supplies	47.58	
Clerical	500.00	$940.29
Convention Expense		1067.15
Proceedings:		
1920	$500.00	
1921	709.88	1209.88
Printing Specifications		192.17
Letter Ballot		84.78
Secretary's Salary		300.00
Committee Expense:		
Membership campaign	$238.73	
Other Committees	121.75	360.48
Clearing House Expense		28.75
Total		$4183.50

Since this report covers but eleven months comparisons with former years will not be accurate. The closing of the books Sept. 1 seemed to be necessary to enable the Secretary and Treasurer to prepare their reports in time for the Convention. Aside from a month of clerical hire there is no indebtedness but the printer's bill for Proceedings and reprints of specifications therefrom. This was not received in time to be checked but $500 was paid on it Sept. 1 at his urgent request. The balance due on it will be approximately $2000. The printer had much bad luck from a storm which prostrated power wires for miles and a subsequent epidemic which practically closed his printing house, located in a small town. He should have been able to get the book out two or three months earlier, even with these handicaps. We have another printer who proposes to demonstrate that any delay in getting out the Proceedings is due to the Secretary, so we hope for earlier issue next year. The delay in issue this year delayed bills to advertisers, and a good many members seem to withhold payment of dues until the preceding Volume of Proceedings is received and a reminding bill is also received. This accounts in part for the smaller amount of receipts. The receipts for September would add materially to the sum if they could have been included.

The membership account is also small. The last month before the Convention is the most prolific of applications for membership and should be particularly so this year on account of the activities of the membership committee, on which account there has been thus far special expenditure of about $240.00 for booklet, invitation card, postage and stenographers, but not including extra edition of programs, which will probably cost $75.00. The report of elections by the Executive Committee given to the Society just previous to the reading of this report shows the results of the membership campaign to date. Members can do much to secure the new members desired by adding their word by letter or in person to the efforts of the membership committee. A final personal word seems to be necessary to insure results from any membership campaign.

The Society is now represented on several joint committees and in several organizations, whose purpose is to secure unity of action and prevent duplication of efforts. The list has been extended this year and promises to have still further extensions. The reports of our representatives in these organizations have some of them, been before the Executive Committee, and they will all be presented to the Society on Friday Morning. They are worthy of your interested attention.

REPORT OF THE TREASURER

Linn White, Chicago, Ill.

Receipts:

Balance from former Treasurer, Herman H. Smith	$184.55
Remittance from the Secretary—deposited 12/23/21	1631.82
Remittance from the Secretary—deposited 3/13/22	308.00
Remittance from the Secretary—deposited 6/28/22	1294.25
Remittance from the Secretary—deposited 8/9/22	465.55
Remittance from the Secretary—deposited 9/6/22	386.81
Interest on Liberty Bonds	63.75

Disbursements:

Check No. 206—11/30/21	$8.00	
207—11/30/21	4.50	
208—11/30/21	49.00	
209—11/30/21	500.00	
210—11/30/22	166.63	
211—11/30/22	631.11	
212—11/30/22	159.94	
213—11/30/22	145.99	
214—11/30/22	144.38	
215— 1/31/22	15.00	
216—1/31/22	29.25	
217—1/31/22	50.84	
221—1/31/22	174.55	
223—4/29/22	192.31	
226—4/29/22	128.19	
227—4/29/22	43.03	
228—4/29/22	131.72	
229—4/29/22	214.58	
230—7/31/22	112.75	
231—7/31/22	11.69	
232—7/31/22	135.75	
233—7/31/22	137.67	
234—8/31/22	99.44	
235—8/31/22	97.98	
236—8/31/22	300.00	
237—8/31/22	500.00	
	4184.30	
Balance on deposit	150.43	
	$4334.73	$4334.73

President Rankin: Before we proceed with business I want to speak my appreciation of so many of you being present this morning. I miss one very familiar face, however, a man who has probably attended more of these Conventions than any one here this morning. One of our past Presidents and one of the oldest members, both in years and in membership, that the Society has. I refer, of course, to our friend, whom we all affectionately know as, "Old Man Giddings." I understand from the Secretary that he is not able to attend this Convention.

I would be pleased to entertain a motion that the Secretary be instructed to send him a telegram of greeting from this Convention.

Mr. Kingsley: I move that the Secretary be instructed to send respects of the Society to Mr. Giddings, and the hope that he be with us next year.

The motion was seconded and carried.

President Rankin: The Secretary is extremely busy these days, and I would, if there are no objections, ask another of our old members, Mr. Pollock, if he would be kind enough to draft a telegram which Mr. Brown will then send.

Following is the telegram which was sent.

Cleveland, Ohio.
October 3, 1922.

Mr. Fred Giddings,
Charlotte, North Carolina.

The American Society for Municipal Improvements sends you, our former President and old friend, warmest greetings and hopes to see you with us next year. Your absence is the only thing to mar the complete success of our Cleveland Convention. With best wishes for returned good health.

Charles Carroll Brown,
Secretary.

(As this portion of the Volume of Proceedings goes to press, news is received of the death of Mr. Giddings after several months of illness.)

Candidates for places on the Committee on Nominations were nominated as follows: Mr. E. A. Fisher of Rochester was nominated by Mr. W. A. Howell; Mr. Geo. W. Tillson by Col. Compton; Mr. W. A. Howell by Mr. Hatton; Mr. Frank Pierson by Col. Compton; and Mr. E. A. Kingsley by Mr. E. R. Conant; all were elected.

For the Committee on Place of Meeting. Mr. Kingsley nominated Mr. Compton; Mr. Hatton nominated Mr. Corson; Mr. Collins nominated Mr. Barnes, of Shreveport, La.; Mr. Pollock nominated Mr. Kingsley; Mr. Mullen nominated Mr. Near; and all were elected.

President Rankin: The next business is the introduction of proposed amendments to the Constitution, by Mr. Tillson.

Mr. Tillson: The Constitution requires that these amendments be presented at this meeting. It is only a matter of form, and they will be discussed at the third meeting, so there is no discussion on them this morning. The amendments as finally adopted by letter ballot will be found on page 389.

President Rankin: The consideration of these amendments will be taken up at a later session.

Mr. Compton: About two weeks ago, upon invitation, I attended a meeting of Contractors in the South. That meeting was called more particularly on account of the unusual conditions which exist thruout the country now regarding the transportation of material and car shortage.

At that meeting this resolution was passed, and I was requested to present it at this Convention.

I will read the resolution to you.

Whereas, It has developed in addresses and discussion at this conference that the construction of many million square yards of improved types of pavement in the various states is being seriously delayed thru the shortage in open top car supply, and,

Whereas, failure to complete unfinished sections of important highways before adverse weather renders such completion difficult or impossible would result in serious financial loss to taxpayers and equally serious interruption to traffic, and,

Whereas, it is understood that the question of securing modification of Interstate Commerce Commission orders issued in connection with the coal shortage has been given attention by various national organizations including American Association of State Highway Officials; the National Association of Sand & Gravel Producers; the National Crushed Stone Association and the Associated General Contractors of America, and,

Whereas, it is the sense of this meeting that such activity should be continued and that the matter should be taken up still further with the appropriate railroad organizations.

Therefore, Be It Resolved, that the Secretary be instructed to forward a copy of these resolutions to the American Association of State Highway Officials and each of the other organizations named in these resolutions and a copy to the American Society for Municipal Improvements.

Be It Resolved Further, that this conference heartily commends the efforts of such organizations and urges that they continue unremittingly their efforts to obtain an adequate car supply for road building and that they enlist the moral support of all organizations affected by the restrictions complained of in the construction of needed streets and roads.

Be It Resolved Further, that the foregoing resolutions, while representing the conviction of those present as to the necessity of uninterrupted road construction, are not to be construed as indicating any desire for a curtailment of essential coal deliveries as it is realized that such deliveries must take precedence over the movement of road materials. It is the sense of the meeting, however, that after vital needs are met the completion of year's road building program is of fundamental importance to the nation."

I present a copy of that resolution, Mr. President, and move that it be referred to the Committee on Resolutions.

The motion was seconded.

MR. WARREN: I want to say that it seems to me that resolution is of such importance that you should have far more than a mere perfunctory passage by this body. Most of you know that there are not only whole states, but whole districts in which good road improvements, streets, are held up and construction is practically at a standstill at this time, because of the shortage of cars. I think we should appoint a special committee to cooperate with the other committees and that the matter be given the widest publicity.

The motion was carried.

MR. WARREN: Would this be a proper time to make a suggestion on the matter of membership drawn out by the thought that is expressed by the President? I was very much pleased to notice the recognition the President has given to your associate membership. Incidentally, I want to say that if the name of this Association were changed to the Municipal Society of Engineers, it would almost be a notice to associate members that they were not wanted.

Then, the next step would be in that event to amalgamate with the American Society of Civil Engineers. I believe it is almost a fact that in the line of work in which I am most directly interested (that of street pavement and roads), there has never been an improvement in road construction, whether it be new types of improvement or improvement of old specifications, which has not emanated from the contractors, rather than the engineers. The suggestion I want to make is this:

The one Society, the American Society of Engineering Contractors, which had a large membership and quite a violent activity for a number of years, dropped out of existence.

It was quite unfortunate that it apparently occurred to no one to invite the members of the old American Society of Engineering

Contractors to become members of the Association. If an associate member is not permitted to introduce a resolution, I make the suggestion that a resolution be put, directing the Secretary to get in touch with the old membership of the American Society of Engineering Contractors at this time, and in the name of this body and in the resolution, invite them all to become members of this Association.

President Rankin: I would like to say, Mr. Warren, that I had that thought in mind sometime ago of writing to the Secretary of that Society personally, and asking them to send a representative here, but I felt that it would be rather presuming on my position, without consulting the Society as a whole, so I took no action on it, but personally I would approve of it.

Mr. Warren: My suggestion is that the Secretary get the old list of membership, which is still in existence. I think I could procure a copy and that the Secretary communicate with every one of tnose old members with the thought of joining this Society.

Mr. Fisher: I would make that motion.

The motion, that the Secretary get in touch with the late officials of the American Society of Engineering contractors in the name of the Society, and invite those individual members to become members of this Society, whether active or associate, as their positions qualify them, was seconded and carried.

The Committee on Public Markets, L. D. Cutcheon, Chairman submitted no report.

The report of the Committee on Fire Prevention, Alcide Chausse of Montreal, Chairman, as printed in Advance Papers, was read by title. The report will be found on page 1.

President Rankin: The Secretary has a paper which has come in since the program was printed. It is on sewage purification by means of the Selo Method, by G. E. Gelinas. It should be presented on Thursday morning, but we cannot get thru with any more than we have down for that meeting, and so if there are no objections, I will ask the Secretary to read this paper at this time.

The paper will be found on page 173.

After some announcements of committee meetings, etc., the session adjourned at 11:35 to meet at two o'clock.

Tuesday Afternoon

The meeting convened at two o'clock, President Edward S. Rankin presiding.

The report of the Committee on Water Works and Water Supply, Geo. W. Fuller, Chairman, was presented as printed in Advance Papers. It is on page 261.

The first paper presented was on the Cleveland Water Supply by A. V. Ruggles. The paper and discussion will be found on page 264.

The report of the committee on Municipal Legislation and Finance, James E. Barlow, Chairman, was read by the Secretary in the absence of the Chairman. It will be found on page 269.

Dr. A. R. Hatton of the Department of Political Science of Western Reserve University, Cleveland, gave a very interesting address on the question "Should Municipal Administration be professionalized" a report of which and of the following discussion will be found on page 275.

A paper on Athletic Fields and Stadiums by Arthur Leland was read by the Secretary in the absence of the author. This paper will be found on page 329.

The session adjourned at 4 p.m.

Tuesday Evening

The meeting convened at eight o'clock, President E. S. Rankin presiding.

President Rankin: Since we have a rather full program for this evening, I think we had better call the meeting to order at once. I will call on Mr. Nelson P. Lewis for his report of the General Committee on City Planning on Regional Planning.

Mr. Nelson P. Lewis: Mr. President, Members and Guests of the Society: I see the President is holding me to my pledge, that I would begin at eight o'clock if there were only two people in the room, and as the program states, I propose first to present something which I must call a report of the Committee on City

Planning, and I have taken Regional Planning as the special subject of that report.

You may think that I have unduly emphasized the regional planning work now in progress in the city of New York, but my excuse for doing so is that it is undoubtedly the most comprehensive piece of work of its kind that has yet been undertaken in this or any other country.

The report of the Committee on City Planning of which Mr. Lewis is chairman will be found on page 287, and Mr. Lewis' address on a Regional Plan for New York City and environs will be found on page 293.

PRESIDENT RANKIN: I think we will agree with everything Mr. Lewis said and we could enjoy a lot more of it. At this time I will ask Mr. Abernethy of the Fairchild Aerial Camera Corporation to give us his paper on the "Technique of Aerial Surveys."

A brief stenographer's abstract of Mr. Abernethy's address will be found on page 303.

Papers on "Control of Property Sub-Divisions" by E. A. Fisher, Rochester, N. Y., and on "Treatment of Intersections of Heavily Traveled Traffic Arteries" by Clarence Farrier of the Department of Public Works, Chicago, Illinois, followed, the latter being read by the Secretary in the absence of the author These papers will be found on pages 306 and 312 respectively.

PRESIDENT RANKIN: The next paper is the report of the Sub-Committee on Park Systems and Open Spaces by Mr. J. M. Rice, Consulting Engineer, of the city of Pittsburg.

J. M. RICE: The Sub-Committee on Park Systems and Open Spaces had two duties to perform: One was to carry out the program as laid down at our former convention of studying the park and open space question in detail and bringing in our findings of fact for the consideration of the Society. We have made some progress on the first part of that, covering the question of playgrounds, going into the area served by playgrounds, the types of playgrounds and some features of administration. We haven't been able to agree on some of these features and I am, therefore, unable to present a report on that this evening.

The second feature was the securing of reports upon the specific development of park systems and recreational systems. That has been taken care of in this particular case by a paper presented by Mr. Farnsworth on "Recreational Features." He will tell you his ideas, and as they are based on a long experience, with local conditions here in Cleveland and other cities, I am sure that it will be very helpful to you.

Manuscript for this paper was not furnished for publication.

PRESIDENT RANKIN: I am going to call now on Mr. Requardt.

GUSTAV J. REQUARDT: Mr. Jefferson C. Grinnalds of Baltimore a member of the Sub-Committee on Zoning, has asked me to read his paper, being unable to be here.

The paper on "The Control of the Location of Garages by Zoning," by J. C. Grinnalds will be found on page 323.

The session adjourned at 10:35 o'clock.

WEDNESDAY MORNING, OCTOBER 4

The meeting convened at nine-thirty o'clock, President E. S. Rankin presiding.

PRESIDENT RANKIN: The first paper this morning is the Report of General Committee on Street Paving and Street Design, Street Maintenance and Street Railway Construction, R. Keith Compton, General Chairman, Chairman and Consulting Engineer of Paving Commission, Baltimore, Md.

MR. COMPTON: The General Committee will make no report, but the Chairmen of the several Sub-Committees will make reports.

Mr. W. A. Howell will report on "Street Paving;" Mr. E. R. Conant will report on "Sidewalks and Street Design;" Mr. G. H. Norton on "Street Maintenance," and Mr. Henry Maetzel on "Street Railway Construction."

Mr. Howell will give us his report.

The report will be found on page 5.

Following the report a paper on Value of Present Tests for Granite in Determining the Probable Wear in Pavements was read by C. D. Pollock. The paper and the discussion thereon will be found on page 16.

The report of the Sub-Committee on Sidewalks and Street Design, E. R. Conant, Chairman, followed. The report and the excellent discussion thereon is on page 22.

Vice-President Dutton took the chair.

Secretary Brown read Mr. G. A. Crayton's paper on Crowns of Streets and Highways, printed on page 40.

The "Report of the Sub-Committee on Street Maintenance," George H. Norton, Chairman, followed, as given on page 44 with the discussion thereon.

Chairman Dutton: We will take up the next paper, the Report of Sub-Committee on Street Railway Construction, Henry Maetzel, Chairman.

Secretary Brown: Mr Chairman, Mr. Maetzel is unable to attend this meeting, and he asked me to say a few words as to what his Committee has been doing. As you know, we have been discussing the question of specifications for paving and street car track construction, and Mr. Maetzel, while being Chairman of a General Committee, has been co-operating in the study of this subject, and since he has been here, he has been discussing the matter with our members who are in the street railway line, and they have gone already to the Convention in Chicago this week of the American Electrical Railway Association, and are working out a system of specifications there, which they will refer to us for next year for our discussion.

The Chairman of our Committee on Specifications, Mr. C. E. DeLeuw, is a Chicago man, and he is unable to be here this afternoon, having been called out of the city on business, but he will be present at that meeting. We expect to get something out of it which will be worth while.

I might add that Mr. Maetzel has been ill for quite awhile this year and that has delayed to some extent the amount of work that he is able to do.

Chairman Dutton: The next two papers on the program, Bituminous Surfaced Gravel for Light Traffic Streets, by D. B. Davis, City Engineer, and Building Gravel Roads with Bituminous Surfaces, by Philip P. Sharples, Technical Adviser, are published in Advance Papers. The authors are not present.

It there is any discussion on either paper at this time, we will be glad to hear it. Mr. Davis's paper is on page 48 and Mr. Sharples's on page 55.

If there is no discussion, the last paper on the program is Practical Significance of Some Road Material Tests, by F. H.

Jackson, Senior Assistant Testing Engineer. U. S. Bureau of Public Roads, Washington, D. C.

In the absence of the author the paper was read by title. It will be found on page 62.

The session adjourned at 12 o'clock.

Wednesday Afternoon

The session opened at two o'clock, Vice-President W. W. Horner presiding.

Chairman Horner: The session, this afternoon, will be devoted entirely to reports of Committees on various specifications.

The first on the program is Report of Committee on Specifications for Sheet Asphalt Pavements, Edgar A. Kingsley, Chairman.

Mr. Kingsley: Mr. Chairman, the Sheet Asphalt Committee has gone over this pretty thoroly, and it gives the Chairman of the Committee much pleasure to report that every member of this Committee, which was selected last year, has been present at the meetings of the Committee during this session. I think Mr. Brown told me awhile ago that the Asphalt Committee was the only Committee that had a full membership present at the Convention. Of course, as Chairman of the Committee, I feel quite proud of that fact. It probably, Mr. Chairman, will be unnecessary to read the whole report, as it is quite long. It has all been printed as the Committee passed upon it, and there are merely a few changes—a few amendments suggested—which have been added. The committee suggests looking into the question of measurement of depressions.

Mr. Kingsley read parts of specifications as corrected.

Chairman Horner: I would like to read the Section of the Constitution under which these reports come. (Read.)

Is there a motion in regard to this report before the discussion is started?

Mr. Kingsley: As Chairman of the Committee on Specifications for Sheet Asphalt Pavements, I move that the report be adopted as read.

The motion was seconded.

Chairman Horner: Is there any discussion on this report, or any questions that any one would like to ask the Chairman, Mr. Kingsley?

Mr. Gage: What is to be done about the sand?

Mr. Kingsley: That matter was discussed by the Committee, and we felt that it was better to leave it as we had it. The engineer, under the specifications, must be in a large measure his own judge, and he will be compelled, of course, to adopt the most available sand which will give the very best results.

Mr. Gage: It is my impression that engineers hesitate in making changes on these specifications. I think it would be better to make the requirements a little more elastic, and instead of 20 to 40, change it to 25 to 40, in order to meet local conditions.

Mr. Kingsley: These are not intended to be adopted. They are merely submitted to the Association. We can not adopt them today. This question of sand grading was threshed out pretty thoroly, and the Committee was unanimous in deciding that we had better leave it as it was, because the notes refer it back to the engineers, calling attention to the various little details, which the engineer must look after.

Chairman Horner: I believe under rolling, you speak of weight of rolls, but do not mention type. Has the Committee discussed that?

Mr. Kingsley: Quite fully, Mr. Chairman, and in regard to this matter the Committee feels that, if possible, excepting for the question of cross rolling, they would like to have a three-wheel roller, but with that you cannot get a smooth surface, and the matter was left as it is.

Chairman Horner: Is there any further discussion? If not, I will call for the question on Mr. Kingsley's report, which provides for the approval of these specifications.

The motion was carried.

The specifications as approved are as follows:

PROPOSED SPECIFICATIONS FOR SHEET ASPHALT PAVEMENTS

Sec. 1. General Description. The sheet asphalt pavement shall consist of a binder course and a wearing course, laid upon a suitable base. The binder course shall be laid upon the prepared base to a finished thickness of one and one-half (1½) inches. The surface course shall be laid upon the compacted binder course to a finished thickness of one and one-half (1½) inches.

Materials

Sec. 2. Stone for Binder Course shall be produced from tough durable rock having a percent of wear of not more than six (6). It shall be of reasonably uniform quality thruout and shall be clean and free from dust and an excess of flat or elongated pieces. When tested by means of laboratory screens and sieves it shall meet the following requirements:

	percent
Passing 1¼-inch screen, not less than	95
Passing ½-inch screen, retained on ¼-inch screen	15–35
Passing ¼-inch screen, retained on 10-mesh sieve, not less than	10
Passing 10-mesh, not more than	10

Sec. 3. Sand for Binder Course shall consist of clean, hard, angular grains, free from clay, loam or other foreign matter and when tested all shall pass a ¼-inch laboratory screen.

Sec. 4. Sand for Surface Course shall consist of clean, hard, angular grains, free from clay, loam and other foreign matter and when tested by means of laboratory sieves shall meet the following requirements:

PASSING	RETAINED ON	PERCENT	
10-mesh		98 to 100	
10-mesh	20-mesh	5 to 15	18 to 50
20-mesh	30-mesh	5 to 15	
30-mesh	40-mesh	8 to 25	
40-mesh	50-mesh	5 to 30	30 to 60
50-mesh	80-mesh	5 to 40	
80-mesh	100-mesh	6 to 20	20 to 40
100-mesh	200-mesh	10 to 25	
200-mesh		0 to 5	

Sec. 5. Mineral Filler shall consist of thoroly dry limestone dust, slate dust or portland cement which when tested by means of laboratory sieves, shall meet the following requirements:

	percent
Passing 30-mesh sieve	100
Passing 200-mesh sieve, not less than	65

Sec. 6. Asphalt Cement shall be homogeneous, free from water and shall not foam when heated to 175°C. (347°F.). It shall meet the following requirements for physical and chemical properties:

I. Penetration at 25°C. (77°F.), 100 grams, 5 seconds......30–60
(Between these limits the exact penetration desired shall be specified by the engineer. An asphalt cement having a penetration 5 points above or below that specified shall be considered acceptable for use.)

II. Flash Point, (open cup) not less than........175°C. (347°F.)

III. Loss on heating at 163°C. (325°F.), 50 grams, 5 hours, not more than..2 percent
Penetration at 25°C. (77°F.), 100 grams, 5 seconds, of residue as compared with penetration of asphalt cement before heating, not less than..............60 percent

IV. Ductility at 25°C. (77°F.), not less than..............30 cm.

V. Proportion of bitumen soluble in carbon tetrachloride, not less than.................................99 percent

Sec. 7. Sources of Supply. (a) Approval of sources of supply of binder stone, sand and mineral filler under these specification shall be obtained from the engineer prior to delivery of material and samples of each shall be submitted as directed by the engineer.

(b) A one pound sample of the asphalt cement that the contractor proposes to use in his work must be submitted to the engineer before the use of such material in the work is permitted. If the contractor proposes to prepare the asphalt cement at the paving plant then, in lieu of the above, a one pound sample each of flux and refined asphalt must be submitted together with a statement as to the proportions in which they will be combined to produce the asphalt cement which he proposes to use. Every refined asphalt and asphalt cement admitted under these specifications shall be equal in quality to the recognized standard for its particular kind or type of asphalt.

(c) Unless otherwise permitted by the engineer, all samples shall be submitted at least three weeks prior to use of the materials in the work and in no case shall they be used until they have been examined and approved by him. Whenever during the course of the work, new deliveries of paving materials are received by the contractor, samples of these shall at once be submitted to the engineer and their use in the work will not be permitted until they have been examined and approved by him.

Sec. 8. Methods of Testing. Methods of testing shall be as follows:

(a) Percent of wear of rock, Standard Test D2–08, American Society for Testing Materials.

(b) Screen test of binder stone, Standard Method D18–16, American Society for Testing Materials.

(c) Sieve test of sand and mineral filler, Standard Method D7-18, American Society for Testing Materials.

(d) Physical and Chemical Properties of Asphalt Cement.

I. Penetration, Standard Test D5-21 American Society for Testing Materials.

II. Flash Point, Tentative Method D92-21T, American Society for Testing Materials.

III. Loss on heating, Standard Method D6–20, American Society for Testing Materials.

IV. Ductility, Tentative Method D113–21T, American Society for Testing Materials.

V. Proportion of bitumen soluble in carbon tetrachloride, U. S. Dept. of Agriculture Bulletin 314, p. 30.

Paving Plant Operation

Sec. 9. Plant Essentials. (a) The plant used in manufacturing the pavement must be of the batch type and capable of mixing in the manner herein specified not less than 80 tons of surface mixture per day of eight hours and must be provided with separate chambers for heating and mixing the ingredients. The stone and sand shall be heated in a suitably designed revolving drier. The mixing shall be done in a twin-shaft mixer of the pugmill type capable of holding and properly mixing not less than a 750-pound batch of surface mixture. Each plant must be provided with asphalt kettles of such capacity that one filling of them will be sufficient for a day's run and so designed as to secure uniform heating of the entire contents. There shall also be provided a bin for the storage of hot aggregate having a storage capacity of not less than one ton and provided with at least two compartments. It shall have an overhead 6- or 8-mesh rotary screen not less than 6 feet long, for separating the coarse and fine aggregate and delivering them to the separate compartments; also a screen for rejecting oversize binder stone; bins and screen to be provided with overflow pipes. The hopper into which the hot aggregate is drawn from the bin must rest upon a set of scales so arranged that a definite weight of material can be weighed out of the bin and delivered to the mixer.

(b) The asphalt bucket used to measure and apply the asphalt must be balanced upon a set of scales and so arranged that the asphalt can be easily and quickly weighed and be applied in a thin sheet the full width of the mixer.

(c) The plant shall be provided with an asphalt thermometer for the melting kettles (of the recording type where steam heat is not used) an electric pyrometer at the discharge chute of the drier, a platform scale and at least two inspector's armored thermometers.

(d) The different kinds of sand and stone used shall be kept separate and such provisions as are deemed necessary by the engineer to keep them from becoming mixed shall be made by the contractor.

Sec. 10. Plant Testing Equipment. The contractor shall provide and maintain in good order at the plant the following testing equipment, which may be used by the engineer or an inspector designated by him to determine the penetration of asphalt and asphalt cement, the grading of the mineral aggregate and such other tests as are deemed necessary:

1 Penetration machine with needles, glass dish and thermometer.
1 Set of standard sieves, 10, 20, 30, 40, 50, 80, 100 and 200 mesh.
1 Laboratory stone scale.
1 Laboratory sand scale.
1 Set of standard screens, 1¼, ½- and ¼-inch circular openings.
1 Roll of manila paper for making pat tests.

All of the above mentioned apparatus shall be of standard type and approved by the engineer and shall be properly housed by the contractor in a separate building or room not less than ten (10) feet by ten (10) feet and provided with a work-bench. This room shall be used exclusively for testing purposes by the contractor and the engineer or his inspector.

Sec. 11. Preparation of Asphalt Cement. (a) The asphalt cement shall be melted at the paving plant in kettles or tanks and shall be brought to a temperature of 250°F. to 350°F.

(b) When refined asphalt is to be combined with a flux or when the asphalt cement contains over 5 percent mineral matter the mixture shall be thoroly agitated until a homogeneous asphalt cement of the required penetration is produced, after which only sufficient agitation shall be provided to keep the asphalt cement homogeneous. The penetration of the asphalt cement shall be tested at suitable intervals to insure that it is maintained at a uniform consistency thruout the period of use.

Sec. 12. Preparation of Mineral Aggregates. (a) The stone and sand for binder course shall be dried and heated at the paving plant to a temperature of 250°F. to 350°F. as determined on the mixing platform. Both may be simultaneously fed into the same drier but in such case they shall immediately after heating be screened into coarse and fine aggregate and stored in separate bins.

(b) The sand for surface course shall be dried, heated, and separately stored at the paving plant as described in the preceding paragraph. The sand shall be heated to a temperature of 275°F. to 400°F. as determined on the mixing platform. When a mixture of two or more sands is required in order to produce the grading specified in Sec. 4 such combination shall be made before the sand is fed into the drier by proportioning the sands from separate storage piles and mixing them by means of shovels.

Sec. 13. Preparation and Composition of Binder Mixture. (a) The hot coarse aggregate, sand and asphaltic cement for binder course shall be measured separately and accurately by weight for each batch to be mixed. The mixture shall be made by first charging the mixer with the mineral aggregate and then adding the asphalt cement. Mixing shall then be continued for a period of at least thirty (30) seconds, or longer if necessary to produce a homogeneous mixture, in which all particles of the mineral aggregate are uniformly coated.

(b) The binder mixture shall conform to the following composition limits, by weight.

	percent
Coarse aggregate retained on 10-mesh sieve	65 to 80
Sand and material passing 10-mesh sieve	15 to 30
Bitumen, soluble in carbon disulphide	4 to 6

The proportions of the several constituents shall be varied as directed by the engineer to produce a mixture suitable in his judgment for the traffic and climatic conditions and coming within the limits above designated.

Sec. 14. Preparation and Composition of Surface Mixture. The hot sand, the mineral filler and asphaltic cement shall be measured separately and accurately by weight for each batch to be mixed. The mixture shall be made by first charging the mixer with the sand and mineral filler. After the two have been thoroly mixed, the asphalt cement shall be added and the mixing continued for a period of at least one (1) minute, or longer if necessary to produce a homogeneous mixture, in which all particles of the mineral aggregate are uniformly coated.

(b) The surface mixture shall conform to the following composition limits, by weight.

	percent
Passing 10-mesh, retained on 40-mesh sieve	12 to 40
Passing 40-mesh, retained on 80-mesh sieve	22 to 45
Passing 80-mesh, retained on 200-mesh sieve	14 to 32
Passing 200-mesh sieve	10 to 20
Bitumen, soluble in carbon disulphide	9.5 to 12

The proportions of the several constituents shall be varied as directed by the engineer to produce a mixture suitable in his judgment for the traffic and climatic conditions and coming within the limits above designated.

Sec. 15. Paving Plant Inspection. The engineer or his authors ized representatives shall have access at any time to all part- of the paving plant in order to insure the manufacture of the pavement in strict accordance with these specifications.

Construction

Sec. 16. Transportation of Mixtures. The binder and surface mixtures shall be transported from the paving plant to the work in tight vehicles previously cleaned of all foreign materials and when directed by the engineer each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions. No loads shall be sent out so late in the day that they cannot be spread and compacted during daylight unless artificial light satisfactory to the engineer is provided.

Sec. 17. Placing Binder Mixture. Prior to the arrival of the binder mixture on the work the prepared base shall be cleaned of all loose and foreign materials. The mixture shall be delivered at a temperature of 225°F. to 325°F. The temperature of the binder mixture within these limits shall be regulated according to its workability and the atmospheric temperature. A variation of 20°F. above or below the temperature set by the engineer shall be allowable. It shall be laid only upon a base which is dry or at least free from standing water and only when weather conditions are suitable. Upon arrival on the work the binder mixture shall be dumped outside of the area on which it is to be spread and shall then immediately be distributed into place by means of hot shovels and spread with hot rakes in a layer of uniform density and correct depth. No more binder course shall be placed in advance of laying the surface course than can be covered by one day's run of the paving plant on surface mixture.

Sec. 18. Compacting Binder Course. (a) Immediately after spreading, the binder course shall be thoroly and uniformly compressed by a power-driven roller weighing not less than ten (10) tons. Rolling shall start longitudinally at the sides and gradually proceed toward the center of the pavement. The motion of the roller shall at all times be slow enough to avoid displacement of the hot mixture, and any displacements shall at once be corrected by the use of rakes and of fresh mixture where required. Rolling shall proceed continuously at an average rate not to exceed three hundred (300) square yards per hour per roller, and shall continue until no further compression is possible. To prevent adhesion of the binder mixture to the roller, the wheels shall be kept properly moistened, but an excess of either water or oil will not be permitted.

(b) At all places not accessible to the roller the binder course shall be thoroly compacted with hot tampers.

(c) The surface of the binder course after compression shall be one and one-half ($1\frac{1}{2}$) inches below and parallel to the established grade of the finished pavement. The thickness of the finished binder course shall average $1\frac{1}{2}$ inches and not more than 40 per cent variation from the average thickness specified will be permitted at any one spot. The surface, after compression, shall show at no place an excess of asphalt cement and any spot showing such excess shall be cut out and replaced with fresh hot binder mixture and immediately compacted to conform with the surrounding area. Any binder mixture which becomes loose or broken, or in any way defective prior to laying the surface course shall be removed, and replaced with fresh hot binder-course mixture, (or if the area does not exceed 5 sq. yds. hot surface mixture may be used) and immediately compacted to conform with the surrounding area.

Sec. 19. Joints in Binder Course. Placing of the binder mixture shall be as nearly continuous as possible. In any case, when the laying of the binder mixture is continued it shall be placed in close contact to the exposed edge of the binder course previously laid so that an even well compacted joint is produced after rolling.

Sec. 20. Placing Surface Mixture. (a) Prior to delivery of the surface mixture the binder course shall be kept as clean and as free from traffic as possible. If not thoroly clean it shall be swept off immediately before the surface mixture is placed. Contact surfaces of curbings, gutters, manholes, etc., shall be painted with a thin uniform coating of hot asphalt cement or asphalt cement dissolved in naphtha, just before the surface mixture is placed against them.

(b) The mixture shall be delivered at a temperature of 250°F. to 350°F. and shall preferably be placed upon the binder course while the latter is still warm. The temperature of the surface mixture within these limits shall be regulated according to its workability and the atmospheric temperature. A variation of 20°F. above or below the temperature set by the engineer shall be allowable. It shall be placed only when weather conditions are suitable. Except with the permission of the engineer no mixture shall be laid when the air temperature on the road is below 40°F. Upon arrival on the work the surface mixture shall be dumped outside of the area on which it is to be spread and shall then immediately be distributed into place by means of hot shovels and spread with hot rakes in a loose layer of uniform density and correct depth. Loads shall not be dumped any faster than they can be properly handled by the shovelers. The shovelers shall not distribute the dumped load faster than it can be properly handled by the rakers. The rakers will not be permitted to stand in the hot mixture while raking it except where necessary to correct errors in the first raking. Immediately adjacent to flush curbings, gutters, liners and other structures the surface-course mixture shall be spread uniformly high so that after compaction it will be one quarter ($\frac{1}{4}$) inch above the edges of such structures.

Sec. 21. Compacting Surface Course. (a) The mixture shall be given its initial compression by rolling with a power driven roller weighing not less than ten (10) tons, as soon after being raked as it will bear the roller without undue displacement or hair cracking. Delays in rolling the freshly raked mixture will not be tolerated. Rolling shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least one-half the width of the roller. The pavement shall then be subjected to diagonal rolling in two directions, the second diagonal rolling crossing the lines of the first. If the width of the pavement permits, it shall in addition be rolled at right angles to the center line. The motion of the roller shall at all times be slow enough to avoid displacement of the hot mixture and any displacements occurring as a result of reversing the direction of the roller, or from any other cause shall at once be corrected by the use of rakes and of fresh mixture where required. Rolling shall proceed continuously at an average rate of not to exceed one hundred fifty (150) square yards per hour per roller, until all roller marks are eliminated and no further compression is possible. The rollers should preferably be operated at a speed of approximately one hundred (100) feet per minute and will not be permitted to exceed a speed of one hundred fifty (150) feet per minute. They shall be in good condition and for final compaction shall weigh not less than two hundred (200) pounds to the inch width of tread. They shall be operated by competent and experienced roller engineers and must be kept in continuous operation as nearly as practicable in such a manner that all parts of the pavement shall receive substantially equal compression. During an 8-hour day in laying asphalt mixture each roller must be engaged in actual rolling for not less than 6$\frac{1}{2}$ hours, not more than 1$\frac{1}{2}$ hours being allowed for clearing fires, watering, etc. This ratio shall be maintained for other periods of laying mixture. To prevent adhesion of the surface mixture to the roller, the wheels shall be kept properly moistened, but excess of either water or oil will not be permitted. Before final compression a light uniform coating of limestone dust or portland cement shall be swept over the surface of the pavement and the rolling then continued.

(b) Along curbs, headers and similar structures, and at all places not accessible to the roller, the surface mixture shall be thoroly compacted with hot tampers and all joints shall be sealed.

(c) The surface of the pavement after compression shall be smooth and true to the established crown and grade. The thickness of the finished surface course shall average 1½ inches and not more than 10 per cent variation from the average thickness specified will be permitted in any one spot. Any low or defective places shall be immediately remedied by removing the surface-course mixture at such spots, and replacing it with fresh hot surface-course mixture which shall be immediately compacted to conform with the surrounding area. The finished pavement shall have a contour substantially conforming to the grade set by the engineer and shall be free from any depressions which exceed ¼ of an inch in depth as measured with a 6 ft. straight edge paralleling the center line of the roadway. It must be free from porous or rough spots that will remain wet after the balance of the surface has dried.

Sec. 22. Joints in Surface Course. Placing of the surface course shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of this course is to be discontinued for such length of time as to permit the mixture to become chilled. Joints between old and new pavements or between successive day's work shall be carefully made in such a manner as to insure a thoro and continuous bond between the old and new surfaces. Except when a canvas-rope joint is used, the edge of the old pavement shall be cut back for the full depth of the service course so as to expose a fresh surface, after which the hot surface mixture shall be placed in contact with it and raked to a proper depth and grade. Hot smoothers, and, or, tampers shall be carefully employed in such a manner as to heat up the old pavement sufficiently (without burning it) to insure a proper bond.

Sec. 23. Protection of Pavement. If at the time of laying binder and surface mixtures, permanent side supports such as curbs, edgings, or gutters have not been constructed, planks of suitable thickness shall be laid along each side of the pavement and spiked or otherwise fastened in place so as to prevent the mixture from squeezing out under the roller. These planks shall remain in place until final compaction has been obtained. Sections of newly finished pavement shall be protected from traffic for at least six hours or until they have become properly hardened by cooling.

NOTES ON SPECIFICATIONS FOR SHEET ASPHALT PAVEMENT

The accompanying specifications are recommended for use under what may be termed average conditions. It is realized however that no single standard specification will satisfactorily cover all variations in local conditions which may prevail for individual jobs. *Before adopting these specifications verbatim the engineer should therefore give particular attention to the items listed below and if necessary make such changes as are suggested.* In the matter of cross-section a crown of $\frac{1}{4}$-inch to the foot is recommended.

I. Thickness. These specifications call for a total finished thickness or depth of 3 inches. If it is desired to make the depth 2 inches the requirement for thickness of the binder course should be changed from *1½ inches to 1 inch* in Sections 1 and 18.

II. Use of Broken Slag in Binder Course. If it is desired to permit the use of broken slag in the binder course the following changes should be made.

Sec. 2. End of first sentence, insert *or of broken slag having a percent of wear of not more than 10, and weighing not less than seventy (70) pounds per cubic foot for the size specified.*

Sec. 8 (a). First line, insert after *rock* the words *or slag.* Add the following sentence: *When testing slag 4000 cc. loose measure of the size specified in the standard test shall be used.*

Change the designation of paragraphs (*c*) and (*d*) to (*d*) and (*e*) respectively and insert (*c*) *Weight per cubic foot of broken slag, Tentative Method C29-20T, American Society for Testing Materials.*

Sec. 13 (b). Change requirement for percent of bitumen soluble in carbon disulphide from *4 to 6* to *4 to 7.*

III. Use of Gravel in Binder Course. While gravel is not recommended for use in binder course, when it is the only readily available material for coarse aggregate it may be permitted, in which case the following change should be made:

Sec. 2. End of first sentence, insert *or of gravel composed of hard, durable rock particles free from clay or coatings of any character.*

IV. Sand for Surface Course. Under heavy concentrated traffic conditions the sand for the surface course should preferably approach as closely as possible the following typical grading. It is impracticable to specify any exact grading but under the conditions mentioned where it is possible to approximate this grading with a single sand or a combination of two or more available sands the engineer should change the limits specified in Section 4 so as to more closely define the grading required without making the specification so rigid as to be impracticable for his work. If this is not done he should at least require the contractor to work to the typical grading as closely as practicable within the specification limits.

Typical Sand Grading for Surface Mixture

PASSING	RETAINED ON	PERCENT	
10-mesh	20-mesh	10	32
20-mesh	30-mesh	10	
30-mesh	40-mesh	12	
40-mesh	50-mesh	12	40
50-mesh	80-mesh	28	
80-mesh	100-mesh	15	28
100-mesh	200-mesh	13	
200-mesh		0	

V. Asphalt Cement. The most desirable consistency or "penetration" for asphalt cement will vary somewhat with climatic and traffic conditions. In Section 6-I, limits of penetration of from "30 to 60" are specified with a statement that between these limits the exact penetration desired shall be specified by the Engineer. The ranges of penetration suggested for various combinations of climate and traffic are shown in the following table.

TRAFFIC	TEMPERATURE		
	Low	Moderate	High
Light	50–60	50–60	40–50
Moderate	50–60	50–60	40–50
Heavy	40–50	40–50	30–40

VI. Samples. It is recommended that the following procedure be adopted in connection with sampling materials for test.

Samples should be put in clean, dry containers, preferably tin boxes or cans. The following amounts of the different materials are required for test:

	pounds
Binder stone	5
Filler	½
Sand	1
Refined asphalt	1
Asphalt cement	1
Flux	1

Method of Sampling. Extreme care should be taken in every case to obtain a sample which is truly representative of the material to be examined. These samples are for the use of the testing laboratory only and should not be used for testing at the plant before submitting them to the laboratory. The particular precautions to be observed in each case are given below.

Binder Stone. A sufficient number of five-pound samples to be taken from different parts of the pile. These should be thoroly mixed together and reduced by quartering to the desired size.

Filler. Samples should be taken from several bags and mixed.

Sand. Samples should be taken from the interior of the pile where the sand is damp. A sufficient number of one-pound samples to be taken from different parts of the pile. These should be thoroly mixed together and reduced by quartering to the desired size.

Refined Asphalt and Asphalt Cement. (a) in barrels: At least one sample should be taken from each batch. It should be taken at sufficient depth below the surface to insure obtaining representative material free from all dirt or other extraneous matter, and at a point not less than four (4) inches distant from the top and sides of the barrel. (b) in tank cars: The contents of the tank should be heated until completely liquid thruout. It should then be agitated and thoroly mixed by means of air or steam, after which the sample shall be taken from the dome in such a manner as to obtain the asphalt from a point at least three (3) feet below the surface. (c) in kettles: The contents of the kettles must be completely liquid and thoroly agitated previous to and during sampling. The sample may be taken from the pipe thru which the material is delivered to the mixer by means of a clean dipper.

Flux. The directions given for sampling refined asphalt and asphalt cement apply to this material except that under ordinary conditions it is not necessary to agitate the contents of the tank car.

Surface and Binder Mixtures. Samples should preferably be taken on the street after the mixture has been shoveled and raked. Samples taken from the plant shall be obtained from the wagons, special care being observed to avoid material from the top of the load or which appears to vary from the average. Samples should be pressed between a sheet of paper and trimmed while hot to a convenient size.

VII. Methods of Testing Binder and Surface Mixtures. It is recommended that the following laboratory methods be used to determine conformity of binder and surface mixtures with specification requirements.

Determination of Bitumen Content and Mesh Composition of Binder Mixture

Weigh out from 350 to 500 grams of the binder mixture and extract the bitumen from it in a centrifugal extractor or suitable continuous hot extractor using chemically pure carbon disulphide as a solvent for the bitumen. Follow the same general method for the drying and sifting of the mineral aggregate as described in the method for analyzing surface mixtures. The screens and sieves to be used are as follows:

1¼-inch, ½-inch and ¼-inch circular opening, and 10-mesh.

Remarks. The limits of accuracy of this test are as follows:

For bitumen content, three-tenths (0.3) per cent above or below the result obtained. For mesh composition, ten (10) per cent of the result obtained (above or below).

Determination of Bitumen Content and Mesh Composition of Surface Mixtures

The sample of surface mixture should be heated to about 300°F. until soft and ten to twenty grams of it weighed onto a tared S. & S. filter paper No. 595, 11 cm. in diameter. The filter paper and contents should be placed in a funnel and washed with chemically pure carbon disulphide until the washings run thru practically colorless. Dry the filter paper and residue at 250°F. for one-half (½) hour. Open the filter paper carefully and remove the mineral aggregate. Scrape off the dust adhering to the paper as thoroly as possible with a blunt palette knife and add it to the mineral aggregate. Evaporate the filtrate containing the bitumen, burn the bitumen, add the filter paper to it and burn to an ash. Add the ash to the mineral aggregate previously removed from the filter paper and weigh. The difference between the weight of surface mixture originally taken and the combined weight of the ash and residue is considered as the weight of bitumen in the sample. This combined ash and residue is then sifted thru the following sieves (in the order named) and the percentages of the various sized particles calculated: 200, 100, 80, 50, 40, 30, 20, 10.

Sifting shall be continued on each sieve until less than one (1) per cent passed thru the sieve during the last minute of sifting.

If desired, the surface mixture may be extracted in a centrifuge or in any suitable form of extractor with hot chemically pure carbon disulphide and the combined ash from the extracted bitumen and the mineral aggregate sifted as above.

Remarks. The limits of accuracy of this test are as follows:

For bitumen content, three-tenths (0.3) per cent above or below the result obtained. For mesh composition, ten (10) per cent of the result obtained (above or below).

Chairman Horner: The next is the report of the Committee of Specifications for Bituminous Macadam, Bituminous Concrete and Asphalt Block Pavements, Thomas E. Collins, Chairman.

REPORT OF COMMITTEE ON SPECIFICATIONS FOR BITUMINOUS MACADAM, BITUMINOUS CONCRETE AND ASPHALT BLOCK PAVEMENTS

Your Committee on Specifications for Bituminous Macadam, Bituminous Concrete and Asphalt Block Pavements reports as follows:

1. *Bituminous Macadam.* No changes have been suggested or made.

2. *Asphalt Block.* No changes have been suggested or made.

3. *Bituminous Concrete.* We herewith submit new specifications for *Fine aggregate bituminous concrete*, which after a hearing have been revised and corrected by your Committee, who recommend that they be printed and submitted to the Society for adoption by letter ballot.

Respectfully submitted,
THOMAS L. COLLINS, *Chairman*,
R. B. GAGE,
MONROE L. PATZIG.

MR. COLLINS: Therefore, as Chairman of the Committee on Specifications for Bituminous Macadam, Bituminous Concrete and Asphalt Block Pavements, I move that this report be received.

The motion was seconded and carried.

SPECIFICATIONS FOR FINE AGGREGATE BITUMINOUS CONCRETE

Definition: The surface pavement defined below is classified as a fine aggregate bituminous concrete to distinguish it from the same type of pavement prepared using a larger size of aggregate. When the foundation is macadam or telford, it is recommended that this pavement be laid with a binder course.

Thickness and weight: This pavement surface shall be laid in one course upon the foundation specified. It must have an average thickness of not less than two (2) inches after ultimate compression and shall not be less than one and three-quarter ($1\frac{3}{4}$) inches nor more than two and one-half ($2\frac{1}{2}$) inches in thickness at any one point. It shall have an average weight of not less than two hundred and fifteen (215) pounds per square yard, exclusive of any squeegee coating or metal covering applied.

Materials required: This pavement shall be prepared from broken stone or_______________________, sand, mineral filler and asphaltic cement. These materials must comply with the requirements given therefor below.

When a heavy aggregate is used, such as dolomite or trap rock, the weight per square yard should be increased from two hundred and forty-five (245) pounds to two hundred and fifty (250) pounds respectively.

Composition: The finished pavement, exclusive of any bituminous sealing mixture or metal covering applied, shall not vary in composition more than the limits given below.

	percent
Bitumen content	6½ to 8
Passing a 200-mesh sieve	5 to 8
Passing a 80-mesh sieve and retained on 200-mesh sieve	5 to 15
Passing a 40-mesh sieve and retained on 80-mesh sieve	8 to 20
Passing a 10-mesh sieve and retained on 40-mesh sieve	6 to 18
Passing a ¼-inch screen and retained on a 10-mesh sieve	10 to 25
Passing a ½-inch screen and retained on ¼-inch screen	15 to 45
Passing a ¾-inch screen and retained on ½-inch screen	5 to 25
Total coarse aggregate retained on a 10-mesh sieve	45 to 65

Estimating ingredients: The proportions of the different ingredients required to prepare the pavements shall be determined by weight. The pavement must not vary in composition more than the specified limits given.

The bitumen content is based upon the finished pavement, exclusive of any mineral or bituminous surface coating applied. The exact amount of mineral filler and asphaltic cement to use between the limits defined herein shall be determined by the engineer. In calculating the percentages of the various sizes of ingredients of which the mineral aggregate is composed, the bitumen is included. The actual amount of the different materials for paving mixture used may be estimated from the railroad shipping weights of these ingredients, batches of paving mixture prepared and used, or loads delivered and laid.

Preparation: The quantity of each ingredient required to be used per batch in the preparation of the paving mixture must be accurately determined by either weight or measurement, depending upon the type of plant and kind of material being used. In either case, the devices used in measuring these ingredients must be standardized whenever so requested, also the manner in which these devices are used shall be demonstrated and the quantity of material thus secured verified whenever so ordered by the engineer, or his representative, who shall have access to all parts of of the plant at any time. The equipment used to liquefy the asphalt cement, heat and screen the aggregate, and prepare the paving mixture must be operated in a manner satisfactory to the engineer and comply with the requirements given therefor.

The aggregate must have a temperature of not less than 275°F. nor more than 350°F. when coated with the asphaltic cement. The asphaltic cement, when applied to the aggregate, must have a temperature of not less than 250°F. nor more than 350°F. and must be free from unmelted lumps. The mineral filler may be added cold, but must be thoroly dry.

When the mineral aggregate is not dried and heated in unit batches, it shall be screened and separated after heating into the different sizes required to produce a pavement of the composition specified.[1] Each size must be accurately weighed separately. The asphaltic cement must be weighed or measured into a vehicle designed for this purpose. The mineral filler must also be either weighed or measured separately.

In the preparation of the paving mixture, the required quantity of stone and sand are first added to the mixing chamber, then the asphaltic cement. After the asphaltic cement has become fairly uniformly distributed thruout the aggregate, the mineral filler is added and the mixing continued until a bituminous mixture is secured that is uniform and homogeneous in composition and all the particles of the aggregate are uniformly coated with the asphaltic cement.

The asphaltic cement must be added slowly in a thin sheet, the full width of the mixing chamber. The mineral filler shall be so cast in the mixing chamber that it is evenly distributed over the surface of the bituminous mixture and not dumped in one end. When the asphaltic cement and mineral filler are properly added to the mixing chamber, a batch of paving mixture can be properly prepared in from one (1) to one and one-half ($1\frac{1}{2}$) minutes, otherwise two or more minutes will be required. The formula used for the preparation of all paving mixtures must be approved in writing by the engineer before the preparation of any paving mixture. Any paving mixture prepared upon an unapproved formula will not be accepted.

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[1] It is suggested that the plant be equipped with a 6 or 8-mesh rotary screen to separate the sand from the stone and in addition a $\frac{3}{4}$-inch screen to reject over-size stone.

Hauling and handling: The paving mixture must be kept clean during hauling and handling and covered during transit with canvas or other material which will retain its temperature. The mixture must not be hauled such a distance that segregation of the ingredients takes place or that a crust is formed on the surface, bottom or sides of said mixture which has a temperature lower than that required. The paving mixture must not be delivered to the job any faster than it can be properly handled by the shovelers. It shall be spread immediately after being dumped and must be kept clean until spread. Any part of the paving mixture which gets dirty or cooled below the required temperature will be rejected. All paving mixture must be carefully removed from the spot upon which it was placed before any additional paving mixture is placed thereon. Each load must be dumped outside of the area upon which it will be spread.

The paving mixture, when dumped on the platform or foundation, must have a temperature of between 250°F. and 350°F. Any portions of the paving mixture that have become cooled below 250°F. before being spread, shall be discarded. The paving mixture may be dumped directly on a concrete foundation, but, when the foundation is macadam or telford, it shall be dumped on metal or wooden platforms unless written permission has been secured from the engineer to dump directly on the foundation. The platforms must be of such size that the paving mixture will not fall off when dumped thereon or work off during spreading.

All vehicles used in transporting paving mixtures must have tight-fitting bottoms which will hold hot, thin paving mixtures without leaking. When motor trucks are used, the body shall be insulated for long hauls during cold weather so that the paving mixtures adjacent the ends and sides will not be chilled during transit. All motor trucks used for this purpose must have dump bodies which will permit the rapid unloading of the mixture. The inside surface of all vehicles used for hauling paving mixtures must be oiled just before loading. However, only sufficient oil shall be used to coat the surface. No pools of oil must appear on the bottom of the vehicle.

Spreading and raking: Immediately after the paving mixture has been dumped upon the platform it shall be deposited at once upon the foundation with hot shovels in such a manner that any segregation of the ingredients or irregularities in composition will be eliminated as much as possible. After being thus deposited it shall be so spread with hot iron rakes that, after being thoroly compacted by tamping and rolling, it shall be uniform in composition, have the required thickness, surface finish and contour.

During spreading and raking the workmen must not walk over or stand on the paving mixture except when necessary to correct irregularities in the initial raking. The paving mixture shall not be spread any faster than it can be properly handled by the rakers.

Special care must be used in spreading and raking the wearing surface if porous spots, depressions or projections are to be eliminated. For this purpose the contractor shall employ not less than three (3) rakers for each one hundred (100) square yards of surface pavement laid per hour. Additional rakers must be employed when a greater quantity of pavement is being laid per hour.

Whenever the pavement is laid alongside of brick or concrete gutters, street car tracks, manhole heads or liners, the finished surface adjacent to them shall be left one-quarter ($\frac{1}{4}$) of an inch high in order to provide for subsequent compression by traffic and to avoid depressions which would otherwise be liable to occur at these points.

Rolling: After the paving mixture has been properly spread and raked, it shall be rolled at once. Delays in the initial rolling of the freshly raked mixture will not be permitted. In all places inaccessible to a roller, such as adjacent curbs, gutters, headers, manholes, etc., the required compression shall be secured by the use of hot tampers.

The initial and final rolling of the paving mixture shall be done with either a ten- or twelve-ton, three-wheel power roller or an eight- to ten-ton tandem roller as ordered by the engineer. During the initial rolling the roller shall travel parallel to the axis of the pavement, beginning at each edge and working towards the center. Each trip of the roller shall overlap the preceding one about half the width of the roller. Alternate trips of the roller shall be of slightly different lengths. Subsequent rolling shall be both diagonal and parallel to the axis of the pavement and shall be performed as soon after the initial rolling as it is possible to do so without the formation of hair cracks, blisters or pitting of the surface. The rolling shall be continued at the rate of not more than one hundred and fifty (150) square yards of pavement surface per hour per roller. The roller must not pass off the pavement surface during rolling or stand on the completed pavement which has not cooled to normal temperature.

When more than one hundred (100) square yards of wearing surface are being laid per hour, two rollers shall be kept in use. An additional roller shall be required for each additional one hundred (100) yards of wearing surface per hour. All rollers must be in charge of a competent roller engineer, must be kept in good condition and in continuous operation as nearly as possible. During an eight-hour day, each roller must be engaged in actual rolling for not less than six and one-half ($6\frac{1}{2}$) hours, not more than one and one-half ($1\frac{1}{2}$) hours being allowed for cleaning fires, watering, etc. The ashes from the roller must not be dumped upon the foundation or wearing surface.

The surface of the wheel of the roller must be kept clean at all times and either oiled or wet with water as ordered by the engineer. When the use of water is permitted it shall not be applied in such quantity that surplus water will run off of the wheels of the roller on the pavement.

The rolling shall be so executed that all parts of the pavement will receive equal compression; also, develop any low or high spots caused by improper spreading and raking. The surface of low spots, depressions or blisters shall be roughened with a hot rake, additional material added thereto, and re-rolled immediately. Excess material shall be removed from the high spots. Such repairs should be made as soon after the initial rolling as possible while the pavement is yet soft.

Seal coat: As soon as possible after rolling and while the pavement surface is yet fresh, clean and hot, a seal coat of bituminous cement shall be spread. Cement used for this purpose shall be the same as used in preparing the paving mixture. It shall be applied at a temperature between 250°F. and 350°F. from a squeegee distributer. Any irregularities in distribution of the bitumen over the surface shall be eliminated with rubber squeegees. Only sufficient cement shall be used to coat the surface and fill the surface voids without leaving an excess on the surface. Immediately over this coating, a top dressing of stone chips or pea gravel or a mixture thereof shall be uniformly spread and rolled into the surface. A slight surplus of this dressing shall be left on the surface. During adverse weather conditions, or when the bituminous coating has chilled before the stone covering has been applied, the stone shall be heated to a temperature of not over 300°F. before applying and rolled into the pavement surface at once after being applied.

Condition of finished pavement: The surface of the finished pavement must substantially conform to the grade and contour specified and must be free from depressions or projections which are one-quarter ($\frac{1}{4}$) inch above or below the established grade as determined by a straight edge, five (5) feet in length, laid parallel to the axis of the road. The pavement must be uniform in density and composition, firmly bonded together and free from hair cracks or porous spots. Such portions of the completed pavement as are defective in finish or which do not comply in all respects with the requirements of these specifications, shall be taken up, removed and replaced with suitable material properly prepared and laid in accordance with the requirement of these specifications at the expense of the contractor. The finished pavement must be protected from all traffic by suitable barricades until it is in the proper condition for use.

Joints: The paving shall be so done that the number of joints shall be reduced to a minimum. When a rope or form joint is not used the edges of the previously laid pavement shall be cut off in a straight line far enough back from the edge to insure that the wearing surface has the required thickness. The cut shall be made at a slight angle to the pavement surface and present a smooth, unbroken edge. The face of the joint shall be painted with hot bituminous cement, after which the hot bituminous mixture shall be raked over it to the proper depth. Hot smoothers or tampers shall be carefully employed in such a manner as to insure the proper bond between the two paving mixtures without burning or injuring either. The finished joint must be on the same plane as the adjacent finished pavement. Joints which are above or below the general plane of the pavement surface must be brought to the proper grade or remade.

The faces of all curbs and gutters, iron castings or other objects projecting thru the pavement shall be painted with hot bituminous cement before the adjoining paving mixture is laid. The adjacent paving mixture shall be compressed by ramming with hot iron tampers when the required compression cannot be secured with the roller.

Foundation, Condition of: The foundation, when the bituminous pavement is applied thereon, must be dry, clean and free from all frost or evidences thereof. It must substantially conform to to the grade and crown specified, and comply with the requirements given for the type of foundation being used. When the foundation is in the proper condition to receive the paving mixture, it must be protected from all travel that will injure, deface or carry foreign material upon it.

Edge protection: When the edges of pavements are not protected by a concrete, stone or metal header, four- (4) to six- (6) inch planks of the same thickness as the finished pavement must be used for this purpose, which shall be firmly secured in the required position and left in place until the pavement has been properly rolled and thoroly set.

Construction season: No pavement shall be laid when it is raining or when the weather conditions are such, in the opinion of the engineer, that the proper density and surface finish will not be secured.

Repairing defective pavements: Defective portions of the pavement, such as porous spots, bumps, and depressions, shall be either replaced by new pavement or else so repaired that the pavement is in accordance with the requirements of the specifications. The methods used to make such repairs must be satisfactory to the engineer.

Guarantee: When a pavement is guaranteed for a certain period of time against deterioration caused by travel, bad or inferior workmanship, use of inferior grades of materials, the pavement must be kept free from the visible evidence of injury caused by any of these agencies during this time. Whenever the pavement, in the opinion of the engineer, is injured or destroyed by any of these agencies, it shall be repaired or replaced in the manner and at the time designated by the engineer. If the contractor shall fail to make such repairs within thirty (30) days after being so notified in writing, the engineer may have the work done and the cost thereof shall be recovered by deducting the same from any money due the contractor, or by an action of law against the contractor or his surety, or by either or both methods.

Workmen: The workmen employed by the contractor must have had sufficient experience in the preparation of bituminous paving mixtures and the construction of bituminous pavements to be able to operate the equipment in such manner that the pavement produced will have the required composition, density and surface finish. The men operating the mixing plant, the spreaders, rakers, and roller men must show by the work completed that they have the necessary experience and are making the proper effort to execute the work in the manner required by these specifications. Otherwise, their services must be dispensed with by the contractor.

Plant and equipment: The plant used in preparing all bituminous paving mixtures must be of the batch type, capable of mixing in the manner herein specified not less than ten (10) tons of the paving mixture for each mixer per hour, and must be provided with separate chambers for heating and mixing the ingredients. No direct heat except steam shall be applied to the exterior surface of the mixing chamber or flame thru the same. The aggregate shall be heated in a revolving kiln. The heat must be so regulated that the aggregate can easily be heated to and maintained at the required temperature. The temperature of the uncoated heated aggregate shall be determined by an electric pyrometer, so placed at the discharge chute of the dryer as to automatically register the temperature thereof. When the aggregate is dried and heated in unit batches, the methods employed and apparatus used to measure the quantities of the ingredients required must be such that the mixture will have the required composition.

All mixing plants which do not dry and heat the aggregate in unit batches, must be equipped with a twin-pug mixer, rotary screen, storage bins, hopper and scales.

The rotary screen must separate the aggregate into two or more sizes, exclusive of tailings. This screen must be not less than five (5) feet in length and contain the size openings necessary to produce a paving mixture of the composition herein specified.

The main bin into which the hot screened aggregate falls must be divided to correspond to the different size openings in the rotary screen, and be so arranged that the aggregate from each size screen will pass into its respective bin without getting into the adjacent sub-bins. Each sub-bin must be provided with an overflow that will prevent excess material being accumulated in any one sub-bin. An overflow must also be provided to prevent all material larger than that permitted to be used in the pavement under construction from falling into any of the bins.

Each sub-bin must have a separate outlet with a gate at the bottom, and so arranged that any definite quantity of aggregate can be drawn therefrom. The hopper into which the hot aggregate is drawn must rest upon a set of scales so arranged that any definite weight of material can be weighed out of each sub-bin.

The mixer must be capable of holding and properly mixing at least a seven hundred and fifty (750)-pound batch of paving mixture, and be equipped with full length blades so designed and placed that the paving mixture will be free from streaks or spots that contain excess asphalt cement, filler, or both.

Each plant, regardless of the type of mixer used, must be provided with asphalt kettles of such capacity that one filling of them will be sufficient for a day's run, and an asphalt thermometer for use therein.

The heat must be applied to these kettles in such manner that the asphaltic cement will be uniformly heated without being burned or decomposed.

The asphalt carrier used to measure and apply the asphalt cement must be balanced upon a set of scales. It shall be so arranged that the asphaltic cement can be easily and quickly weighed and poured in a thin sheet between the two lines of paddles the full width of the mixer.

When a squeegee distributer is required to be used, it must be designed for this particular purpose. All equipment and methods used in the preparation and construction of the pavement must be approved by the engineer before being used on this contract.

Material requirements: All materials used must comply with the requirements given herein and must be approved by the engineer before using. The approval of a given material is in effect only as long as the material supplied is of the same character and composition as the sample approved. All materials condemned by the engineer shall be removed at once from the site of the work.

The quantity of materials required shall be determined by weight unless otherwise specified. The railroad shipping weight shall govern in deciding the actual amount furnished or used. The contractor, when requested by the engineer, shall furnish freight bills of all materials received.

Upon receipt of the contract the contractor shall notify the engineer at once in writing the location and source of supply of the different materials to be used.

The methods used in preparing any of the materials required must be of an approved type. The engineer shall have free access to any or all of the plants where said materials are being prepared.

Methods of testing: All materials herein defined shall be tested by the latest standard or tentative standard methods of the American Society for Testing Materials.

Broken stone: Broken stone must be free from particles of stone, coated or partly coated with mud, clay, loam or other foreign material and must not contain over five (5) percent of weathered or partly decomposed rock or over ten (10) percent of stone particles coated or partly coated with the dust of fracture. It must be free from particles of sandstone, feldspar, slate, shale and stone having a percent of wear of over six (6) per cent.

It must be so prepared that it will all pass a three-quarter ($\frac{3}{4}$)-inch screen, twenty-five (25) to seventy-five (75) percent pass a one-half ($\frac{1}{2}$)-inch screen and not over twenty-five (25) percent a one-quarter ($\frac{1}{4}$)-inch screen.

Sand: Sand shall consist of grains of quartz or other hard, durable rock, the surfaces of which are not coated with any foreign material nor worn smooth. The sand shall be free from soft, decomposed or partly decomposed sand grains, lumps of clay, ferruginous cemented sand, coal, mica, organic matter or other foreign material. It shall have the following composition:

	percent
Passing a 200-mesh sieve	0 to 5
Passing a 80-mesh sieve and retained on a 200-mesh sieve	15 to 40
Passing a 40-mesh sieve and retained on a 80-mesh sieve	25 to 60
Passing a 10-mesh sieve and retained on a 40-mesh sieve	15 to 50
Passing a $\frac{1}{4}$-inch screen and retained on a 10-mesh sieve	0 to 2

Mineral filler: Mineral filler shall be a thoroly dry limestone dust or Portland cement, 85 percent of which must pass a 100-mesh sieve and not less than sixty-five (65) percent a two hundred (200)-mesh sieve. It must be free from lumps or balls or any foreign material that may injure it for the use intended.

Asphaltic cement: The asphaltic cement defined herein shall be prepared from a petroleum or from fluxed or unfluxed natural asphalts and must be free from tar or tar products. It must have the consistency required before shipping, be uniform and homogeneous in composition and free from water. It shall have the following properties:

1. Penetration at 77°F................................ 50 to 60
2. Evaporation loss at 325° F., 50 grams, for 5 hrs. Not over 2 percent
3. Penetration of evaporation residue at 77°F. . .Not less than 25
4. Bitumen soluble in carbon tetrachloride, C Cl Not less than 99½ percent
5. Ductility at 50 penetration............Not less than 50 cm.

Chairman Horner: The next is the Report of Committee on Specifications for Broken Stone and Gravel Roads with or without Bituminous Surface Treatment, D. B. Davis, Chairman. Mr. Davis is not here.

Mr. Corson: The time was allotted last evening for a meeting of this Committee in Parlor "J". No one seemed to take any interest in the meeting, and I know nothing of the report, other than that printed in the Advance Papers, with the exception that on page twenty-eight there is a typographical error—"not less than sixty seconds," should be "not more than sixty seconds;" otherwise, the Report stands as prepared by the Chairman. What action the Convention wants to take on it, I will leave to your judgment.

Chairman Horner: Mr. Davis writes: "Your Committee begs to report that after carefully reviewing the tentative specifications submitted at Baltimore last year and receiving the suggestions of interested engineers, we deem it for the best interest of the Society to make a number of changes, and that the same could be brought more clearly to the members of the Society, we have redrafted the specifications in their entirety."

There is also note of Secretary stating: "The specifications proposed at the Baltimore Convention, referred to above, of which the following specifications are modifications, were printed on pages 458–478 of the Proceedings of the 1921 Convention."

There are four independent specifications which come under the Committee's Report, as follows: Gravel Roads, Broken Stone Roads, Surface Treatments, Hot Application, and Surface Treatments, Cold Application.

Is there any discussion on any of these Specifications? If not, I will put the question on the motion as presented by the Committee for the approval of these four specifications.

The motion was carried.

The specifications as above approved are as follows:

PROPOSED SPECIFICATIONS FOR BROKEN STONE ROAD

General Description. The broken stone road shall consist of two or more courses, separately constructed, laid to conform with the lines and grades and cross-sections as shown by the plans.

Sub-Grade. The sub-grade shall be prepared and rolled with a ten (10) ton self-propelled roller until firm, hard and even and shall conform to the lines and grades and the cross-sections as shown by the plans.

Where the sub-grade is unduly soft or clayey, a layer of gravel, cinders or stone screenings shall be placed thereon, in order to keep the sub-grade from working up thru the stone, or there shall be constructed a series or system of underdrainage; the method to be used to be of such nature as to obtain the desired results and to be carried on under the direction of and to the complete satisfaction of the engineer in charge.

Materials. The stone shall be furnished by the contractor and shall be subject to the approval of the engineer. It shall consist of angular fragments of rock newly broken, of uniform quality thruout and free from tailings, slaty, spherical and flat fragments, soft or disintegrated stone, dirt or other matter occurring either in or as a coating on the stone.

The following designations and sizes shall obtain, and all sizes shall be determined by laboratory screens having openings of the diameter specified, and shall conform to Section 4, Serial designation D63–20T, A. S. T. M.

	FOR STONE HAVING A PER CENT OF WEAR FROM 8 TO 4		FOR STONE HAVING A PERCENT OF WEAR UNDER 4	
	Passing	Retained	Passing	Retained
	inches	*inches*	*inches*	*inches*
Dust	¼	0	¼	0
Screenings	1¼	¼	¾	¼
Surface stone	2½	1¼	2½	1¼
Base stone	4	2½	3½	2½

Screenings shall contain not more than 70 percent nor less than 40 per cent by weight of dust.

A sample of rock when subjected to the tests as described in A. S. T. M., Serial Designation D20–08 shall satisfactorily meet the following limiting value: Percent of Wear not more than eight (8).

Construction

Shoulders: During or after the preparation of the sub-grade and before any stone is placed for any course, side forms shall be properly placed, and earth shoulders shall be built up against them along each side to a height equal to the thickness of each course. These shoulders shall be true to grade and of full width as shown on the plans. The shoulders may be built for both base and surface courses before any stone is placed if so desired.

No material containing sod, weeds, roots or other deleterious matter shall be used in the construction of the shoulders.

Upon completion of the surface course, the shoulders shall be thoroly rolled and finished true to grade and line and cross-section as shown on the plans.

Placing Screenings. No coarse material shall be placed until the screenings for filling the same have been neatly stored along the side of the highway.

Base Course. The base shall consist of one or two courses of base stone spread to a depth indicated on the plans.

If the total depth of the finished base is greater than four (4) inches after compaction, it shall be constructed in two (2) courses, both of which shall be made in accordance with the provisions herein mentioned. Side forms shall be used to fix the depth of the loose material. The coarse stone shall be spread uniformly by means of approved spreading devices, or the material shall be deposited on platforms or in piles alongside the road, and shall be shoveled therefrom onto the sub-grade. The stone shall be harrowed to produce a uniform and even distribution if, in the judgment of the engineer, the same is necessary. All patches or areas of fine or undersized materials shall be removed and replaced with suitable material before final rolling and water binding.

Rolling Base Course. The base stone shall be rolled with a self-propelled three-wheel roller weighing not less than ten (10) tons, to such an amount and in such manner as the engineer in charge deems necessary to produce a thoroly compact surface. Any uneven places that develop during rolling shall be loosened and then refilled with the same kind of material as that of which this course is constructed and again rolled as required above.

Applying Screenings. After the dry rolling has been completed as described above, screenings shall be applied gradually over the surface during the finishing process of dry rolling in such an amount as will completely fill the interstices. The screenings shall not be dumped on the surface of the stone, but shall be cast thinly with a spreading motion of the shovel from piles on the roadside. The rolling shall continue while the screenings are being spread, so that the jarring effect of the roller will aid them in settling to the bottom. The screenings shall not be allowed to cake or bridge on the surface of the stone in such a manner as will prevent filling of all voids and direct bearing of the roller on the face of the stone. It may be required that the screenings be swept in with brooms if necessary to properly fill the voids. The spreading and rolling shall continue until no more screenings will go in dry.

Finishing. After dry filling and rolling has been completed as described above, sufficient water shall be applied to the surface, screenings added and rolling continued until a well bound, dense macadam surface is secured.

The roller will not be permitted to stand on the unfinished base, and dumping of ashes or cinders from fire boxes on the stone will not be allowed. The surface of the base course will be maintained in its finished condition until the next course is placed thereon.

Surface Course. Prior to the placing of any surface stone, the base course shall be thoroly swept, in order that it may not present a smooth, slick finish and in order to destroy as far as possible any cleavage plane between the courses. This sweeping of the base course shall be done if, in the judgment of the engineer, it is deemed necessary.

On the completed base course, surface stone (unless otherwise specified) shall be spread in the same manner as specified for the base course. This surface course shall be rolled and finished in exactly the same manner as described above for the base course, and shall be ...... inches in thickness after compaction.

Measurement and Payment. The quantity of broken stone road to be paid for, shall be the number of square yards, measured horizontally, satisfactorily completed in accordance with the specifications. The price stipulated in the bid shall include shaping and rolling the sub-grade and shoulders; furnishing of the different sizes of broken stone; the placing, rolling and watering of the broken stone; and all labor and work and expenses incidental to the completion of the broken stone road.

Work other than that provided in the contract and ordered by the engineer in writing, shall be paid for as agreed previously by the contractor and the engineer.

PROPOSED SPECIFICATIONS FOR BITUMINOUS SURFACE TREATMENT FOR MACADAM ROADS

Hot Application

Description. This treatment shall consist of cleaning the existing road surface, applying the hot bituminous material thereto in one or more applications, and covering same with covering material.

Bituminous Materials. The bituminous material shall conform in all respects to specifications hereinafter specified for Refined Tar "A", Refined Tar "B", or Asphaltic Oil for Hot Application.

The contractor will be required to show to the satisfaction of the engineer, that the company manufacturing the bituminous material has, for a period of at least two years, manufactured it in a thoroly equipped plant; and that the bituminous material that he proposes to use shall have been in continuous and successful use in the surface treatment of broken stone roads for a period of at least two years previous to the date of the letting in which his proposal was submitted.

The bituminous material shall be delivered in suitable containers, far enough in advance of its use in the work to permit the necessary tests to be made. Each container shall be plainly labeled with the trade name of the material, name of the manufacturer, gross weight and net weight. Each shipment and each carload shall be kept separate.

The contractor shall furnish the engineer on or before the arrival of each shipment at or near the site of the work, bills of lading, or correct copies thereof, which shall state the trade name of the bituminous material and the name and address of the company manufacturing it.

Samples will be taken by the engineer from each carload of bituminous material when delivered at the work, unless satisfactory arrangements can be made for sampling before shipment. Such samples shall be analyzed by the engineer to assure a delivery of a bituminous material of the specified quality and to determine for purpose of payment, the quantity of bitumen.

Cover Material. The covering material shall consist of clean, hard, dustless grit or sand, gravel, slag or stone and when tested by means of laboratory screens shall conform to the following requirements:

Passing ¾-inch screen, not less than 85 percent.
Retained on ¼-inch screen, not less than 85 percent.

Preparation of Surface After the surface of the roadway shall have been repaired and is well consolidated and free from any depressions, and when thoroly dry, it shall be cleaned by means of shovels and hand-brooms or by the use of mechanical sweepers of approved type, having steel fiber brooms, until all dust, dirt or other loose material is removed. Special care shall be taken to clean the edges of the surface so that the full width of the road metal to be treated shall be uniformly clean. If the road being cleaned has a bituminous surface, any surplus matted bituminous material not definitely bonded to the surface shall be scraped therefrom.

Applying Bituminous Material. To the clean dry road surface the bituminous material conforming to the specifications and heated to the temperature specified, shall be uniformly applied by means of a pressure distributer of approved type. The bituminous material shall be applied at a pressure of 25 pounds to 75 pounds per square inch. If necessary the bituminous material shall be broomed evenly over the surface before covering is applied. If necessary the bituminous material shall be put on in two or more applications.

No bituminous material shall be applied when the temperature of the atmosphere is below 45°F. nor when the air temperature within the preceding 24 hours has been 35°F. or lower.

The contractor shall furnish and keep on the work at all times an accurate thermometer suitable for determining the temperature of the bituminous material being applied. The distributer shall be so constructed as to make it possible to readily determine the temperature of the bituminous material at any time.

Application of Covering Material. After the bituminous material has been applied, the cover material conforming to these specifications shall be immediately applied to the surface in such quantities as are specified by the engineer in his estimate. No traffic shall be allowed on the newly applied bituminous material until sufficient covering has been applied to prevent the bituminous material from being plucked from the road surface. The contractor shall be required to furnish and keep in a conspicuous place at both ends of the road being treated, plainly legible warning signs.

Basis of Payment. The work shall be paid for at the contract unit prices, which prices will include all material, labor, work and the use of all necessary equipment and tools incident thereto.

The quantity of bituminous material paid for will be computed on the basis of its volume at 60°F.

Proposed Specifications for Refined Tar "A", Low-Carbon Tar for Surface Treatment, Hot Application

The tar shall meet the following requirements:

(a) Water..0.00 percent
(b) Specific gravity at 25°/25°C. (77°/77°F.)..........1.14 to 1.18
(c) Float test at 32°C. (89.6°F.)................60 to 150 seconds
(d) Distillation test:
  Total distillate by weight, 0 to 170°C. (32 to 338°F.) not more than 0.00 percent
  Total distillate by weight, 0 to 235°C. (32 to 455°F.) not more than 4.00 percent
  Total distillate by weight, 0 to 270°C. (32 to 518°F.) not more than 13.00 percent
  Total distillate by weight, 0 to 300°C. (32 to 572°F.) not more than 26.00 percent
  Residue by weight................not less than 74.00 percent
(e) Softening point (Cube-in-water Method) of residue from distillation test...............not more than 75°C. (167°F.)
(f) Free carbon.......................not more than 5.00 percent

The properties enumerated in these specifications shall be determined in accordance with the following methods of test of the American Society for Testing Materials:

(a) Percentage of Water: Tentative Method of Test for Water in Bituminous Materials (Serial Designation: D114–21T).

(b) Specific Gravity: Tentative Method of Test for Specific Gravity of Road Oils, Road Tars, Asphalt Cements and Soft Tar Pitches (Serial Designation: D70–20T).

(c) Distillation: Standard Method of Test for Distillation of Bituminous Materials Suitable for Road Treatment (Serial Designation: D20).

(d) Softening Point: Standard Method of Test for Softening Point of Tar Products (Cube-in-water Method) (Serial Designation: D61).

(e) Float Test: Standard Method of Sampling and Analysis of Creosote Oil (Serial Designation: D38) (Sections 17 and 18).

(f) Free Carbon: Standard Method of Test for Soluble Bitumen (Serial Designation: D4)

The refined tar when applied shall have a temperature between 93°C (200°F.) and 121°C. (250°F.).

Proposed Specifications for Refined Tar "B," High-Carbon Tar for Surface Treatment, Hot Application

The tar shall meet the following requirements:

(a) Water..0.00 percent
(b) Specific gravity at 25°/25°C. (77°/77°F.)..........1.20 to 1.26
(c) Float test at 32°C. (89.6°F.)................60 to 150 seconds
(d) Distillation test:
    Total distillate by weight, 0 to 170°C. (32 to 338°F.) not more than 0.00 percent
    Total distillate by weight, 0 to 235°C. (32 to 455°F.) not more than 10.00 percent
    Total distillate by weight, 0 to 270°C. (32 to 518°F.) not more than 15.00 percent
    Total distillate by weight, 0 to 300°C. (32 to 572°F.) not more than 25.00 percent
    Residue, by weight.............not less than 75.00 percent
(e) Specific gravity at 25°C. (77°F.) of total distillate to 300°C. (572°F.)..................................not less than 1.03
(f) Softening point (Cube-in-water Method) of residue from distillation test...............not more than 75°C. (167°F.)
(g) Free carbon.........................12.00 to 22.00 percent

The properties enumerated in these specifications shall be determined in accordance with the following methods of test of the American Society for Testing Materials:

(a) Percentage ot Water: Tentative Method for Test for Water in Bituminous Materials (Serial Designation: D114–21T).

(b) Specific Gravity: Tentative Method of Test for Specific Gravity of Road Oils, Road Tars, Asphalt Cements and Soft Tar Pitches (Serial Designation: D70–20T).

(c) Distillation: Standard Method of Test for Distillation of Bituminous Materials Suitable for Road Treatment (Serial Designation D20).

(d) Softening Point: Standard Method for Tests for Softening Point of Tar products (Cube-in-water Method) (Serial Designation D61).

(e) Float Test: Standard Method of Sampling and Analysis of Creosote Oil (Serial Designation: D38) (Sections 17 and 18).

(f) Free Carbon: Standard Method of Test for Soluble Bitumen (Serial Designation: D4).

The refined tar when applied shall have a temperature between 93°C. (200°F.) and 121°C. (250°F).

Proposed Specifications for Asphaltic Oil for Hot Surface Treatment

The road oil shall be homogeneous free from water, and shall not foam when heated to 120°C. (248°F.).

It shall meet the following requirements:

(a)	Specific gravity 25°/25°C. (77°/77°F.)	not less than 0.98
(b)	Flash point	not less than 80°C. (176°F.)
(c)	Specific viscosity 100°C. (212°F.)	not less than 60
(d)	Float test at 32°C. (89.6°F.)	not more than 60 seconds
(e)	Loss at 163°C. (325°F.) 5 hours	not more than 15 percent
	A float test on residue 50°C. (122°F.)	not less than 110 seconds
(f)	Total bitumen (soluble in carbon disulphide)	not less than 99.5 percent
(g)	Per cent of total bitumen insoluble in 86°B. naptha	not less than 6.0 percent

The properties enumerated in these specifications shall be determined in accordance with the following methods of test:

Specific viscosity: Method contained in Bul. 314, p. 7, U. S. Dept. of Agric.

Float Test: U. S. D. A. Bulletin 314, p. 9.

Flash Point: Open Cup method, Bulletin 314, p. 17, U. S. Dept. Agric.

Loss on Heating: Bulletin 314, p. 19.

The asphaltic oil shall be applied at a temperature between 135°C. (275°F.) and 177°C. (350°F).

PROPOSED SPECIFICATIONS FOR BITUMINOUS SURFACE TREATMENT FOR MACADAM ROADS

Cold Application

Description. This treatment shall consist of cleaning the road surface, applying the cold bituminous material thereto in one or more applications, and covering the same with covering material.

Bituminous Material. The bituminous material shall conform in all respects to specifications hereinafter specified for Tar, Cut-Back Asphalt Cement and Temporary Substitute for Road Oil.

The contractor will be required to show to the satisfaction of the engineer that the company manufacturing the bituminous material has, for a period of at least two years, manufactured it in a thoroly equipped plant; and that the bituminous material that he proposes to use shall have been in continuous and successful use in the surface treatment of broken stone roads for a period of at least two years previous to the date of the letting in which his proposal was submitted.

The bituminous material shall be delivered in suitable containers, far enough in advance of its use in the work to permit the necessary tests to be made. Each container shall be plainly labeled with the trade name of the material, name of the manufacturer, gross weight and net weight. Each shipment and each carload shall be kept separate.

The contractor shall furnish the engineer on or before the arrival of each shipment at or near the site of the work, bills of lading, or correct copies thereof, which shall state the trade name of the bituminous material, and the name and address of the company manufacturing it.

Samples will be taken by the engineer from each carload of bituminous material when delivered at the work, unless satisfactory arrangements can be made for sampling before shipment. Such samples shall be analyzed by the engineer to assure a delivery of a bituminous material of the specified quality and to determine for purpose of payment the quantity of bitumen.

Cover Material. The covering material shall consist of clean, hard, dustless grit or sand, gravel, slag or stone and when tested by means of laboratory screens shall conform to the following requirements:

Passing ¾-inch screen, not less than 85 per cent.
Retained on ¼-inch screen, not less than 85 per cent.

Preparation of Surface. After the surface of the roadway shall have been repaired and is well consolidated and free from any depressions and when thoroly dry, it shall be cleaned by means of shovels and hand-brooms or by the use of mechanical sweepers of approved type, having steel fiber brooms, until all dust, dirt or other loose material is removed. Special care shall be taken to clean the edges of the surface so that the full width of the road metal to be treated shall be uniformly clean. If the road being cleaned has a bituminous surface, any surplus matted bituminous material not definitely bonded to the surface shall be scraped therefrom.

Applying Bituminous Material. To the clean dry road surface, the bituminous material conforming to these specifications shall be uniformly applied by means of a pressure distributer of approved type. The bituminous material shall be applied at a pressure of 25 pounds to 75 pounds per square inch. If necessary the bituminous material shall be broomed evenly over the surface before covering is applied. If necessary the bituminous material shall be put on in two or more applications.

No bituminous material shall be applied when the temperature of the atmosphere is below 45°F. nor when the air temperature within the preceeding 24 hours has been 35°F. or lower.

Application of Covering Material. After the bituminous material has been applied, the cover material conforming to these specifications shall be immediately applied to the surface in such quantities as are specified by the engineer in his estimates. No traffic shall be allowed on the newly applied bituminous material until sufficient covering material has been applied, to prevent the bituminous material from being plucked from the road surface. The contractor shall be required to furnish and keep in a conspicuous place at both ends of the road being treated, plainly legible warning signs.

Basis of Payment. The work shall be paid for at the contract unit prices which prices will include all material, labor, work and the use of all necessary equipment and tools incident thereto.

The quantity of bituminous material paid for will be computed on the basis of its volume at 60°F.

Proposed Specifications for Low-Carbon Tar for Surface Treatment, Cold Application.

The tar shall meet the following requirements:

(a) Water............................not more than 2.00 percent
(b) Specific gravity at 25°/25°C. (77°/77°F.)..........1.10 to 1.14
(c) Specific viscosity, Engler, 50 cc. at 40°C. (104°F.)....20 to 35
(d) Distillation test on water-free material:
    Total distillate by weight, 0 to 170°C. (32° to 338°F.) not more than 2.00 percent
    Total distillate by weight, 0 to 235°C. (32° to 455°F.) not more than 15.00 percent
    Total distillate by weight, 0 to 270°C. (32° to 518°F.) not more than 30.00 percent
    Total distillate by weight, 0 to 300°C. (32° to 572°F.) not more than 40.00 percent
    Residue, by weight.............not less than 60.00 percent
(e) Softening point (Cube-in-water Method) of residue from distillation test...............not more than 70°C. (158°F.)
(f) Free carbon.....................not more than 5.00 percent

The properties enumerated in these specifications shall unless otherwise indicated be determined in accordance with the following methods of test of the American Society for Testing Materials:

(a) Percentage of Water: Tentative Method of Test for Water in Bituminous Materials (Serial Designation: D114–21T).

(b) Specific Gravity: Tentative Method of Test for Specific Gravity of Road Oils, Road Tars, Asphalt Cements and Soft Tar Pitches (Serial Designation: D70–20T).

(c) Specific Viscosity: Method Contained in Bulletin No. 691, U. S. Department of Agriculture, the instrument being standardized by the Bureau of Standards. The results shall be reported as specific viscosity compared with water at 25°C. (77°F.)

(d) Distillation: Standard Method of Test for Distillation of Bituminous Materials Suitable for Road Treatment (Serial Designation D20).

(e) Softening Point: Standard Methods of Test for Softening Point of Tar Products (Cube-in-water Method) (Serial Designation D61).

(f) Free Carbon: Standard Method of Test for Soluble Bitumen (Serial Designation: D4).

Proposed Specifications for High-Carbon Tar for Surface Treatment, Cold Application

The tar shall meet the following requirements:

(a) Water	not more than 2.00 percent
(b) Specific gravity at 25°/25°C. (77°/77°F.)	1.14 to 1.18
(c) Specific viscosity, Engler, 50 cc. at 40°C. (104°F.)	8 to 20
(d) Distillation test on water-free material:	
Total distillate, by weight, 0 to 170°C. (32 to 338°F.)	not more than 7.00 percent
Total distillate. by weight, 0 to 235°C. (32 to 455°F.)	not more than 18.00 percent
Total distillate, by weight, 0 to 270°C. (32 to 518°F.)	not more than 28.00 percent
Total distillate, by weight, 0 to 300°C. (32 to 572°F.)	not more than 35.00 percent
Residue, by weight	not less than 65.00 percent
(e) Specific Gravity at 25°/25°C. (77°/77°F.) of total distillate at 300°C. (572°F.)	not less than 1.01
(f) Softening point (Cube-in-water Method) of residue from distillation test	not more than 60°C. (140°F.)
(g) Free carbon	4.00 to 12.00 percent

The properties enumerated in these specifications shall unless otherwise indicated be determined in accordance with the following methods of test of the American Society for Testing Materials:

(a) Percentage of Water: Tentative Method of Test for Water in Bituminous Materials (Serial Designation: D114–21T).

(b) Specific Gravity: Tentative Method of Test for Specific Gravity of Road Oils, Road Tars, Asphalt Cements and Soft Tar Pitches (Serial Designation: D70–20T).

(c) Specific Viscosity: Method Contained in Bulletin No. 691 U. S. Department of Agriculture, the instrument being standardized by the Bureau of Standards. The results shall be reported as specific viscosity compared with water at 25°C. (77°F).

(d) Distillation: Standard Method of Test for Distillation of Bituminous Material Suitable for Road Treatment (Serial Designation D20).

(e) Softening Point: Standard Method of Test for Softening Point of Tar Products (Cube-in-water Method) (Serial Designation D61).

(f) Free Carbon: Standard Method of Test for Soluble Bitumen (Serial Designation D4).

Proposed Specifications for Cut-Back Asphalt Cement

The cut-back asphalt cement shall be homogeneous and shall meet the following requirements for physical and chemical properties:

(a) Specific viscosity, Engler, 25°/25°C. (77°/77°F.).....30 to 120
(b) Loss at 163°C. (325°F.), 5 hours.....25 percent to 36 percent
(c) Penetration of residue at 25°C. (77°F.), 100 g., 5 seconds 30 to 75
(c) Percent of total bitumen, insoluble in 86° B Naphtha not less than 12 percent
(d) Specific gravity 15.5°/15.5°C. (60°/60°F.) of total distillate to 260°C. (500°F.)..................not more than 0.778
Ductility of residue at 25°C. (77°F.).........not less than 40

The properties enumerated in these specifications shall be determined in accordance with the following methods of test:

(a) Specific viscosity (first 50 cc.) U. S. Department of Agriculture Bulletin 314, p. 7.

(b) Bitumen insoluble in naptha, U. S. Department of Agriculture Bulletin 314, p. 28.

(c) Distillation test, A. S. T. M. Standard Test D20–16.

Temporary Substitute for Road Oil

Its specific gravity at 25°/25°C. (77°/77°F.) shall not be less than 0.835 nor more than 0.970.

It shall have a flash point of not more than 50°C. (122°F). when tested in an open-cup oil tester.

When tested by means of the Engler Viscosimeter at 25°C. (77°F.) the specific viscosity of the first 50 cubic centimeters passing the orifice of the viscosimeter shall be not less than 80 nor more than 120.

When 20 grams of the material is maintained at a uniform temperature of 163°C. (325°F.) for 5 hours, in an open cylindrical tin dish 5½ cm. (about 2¼ inches) in diameter, with vertical sides measuring approximately 3½ cm. (about 1½ inches) in depth, the loss in weight shall be not less than 30 percent.

When the residue is tested by means of The New York Testing Laboratory float apparatus, the float shall not sink in water maintained at 50°C. (122°F.) in less than 90 seconds.

Its bitumen as determined by its solubility in chemically pure carbon disulphide at room temperature shall be not less than 99.5 percent.

It shall be soluble in 86° B. paraffin naphtha to the extent of not less than 94 per cent of its bitumen as determined by Clause 5.

Harrowing Gravel. After the gravel has been spread, if in the opinion of the engineer in charge harrowing is desirable, it shall be harrowed until a uniform texture of surface is secured.

If in the opinion of the engineer the gravel to be used does not contain a sufficient amount of binder, clay or other suitable binding material, the required amount, not exceeding 15 percent, of approved quality, shall be applied uniformly to the surface, and thoroly incorporated with the gravel until the maximum density is obtained.

Rolling and Watering. After the gravel has been spread and shaped to the proper cross-section, it shall be rolled with a three-wheel power roller weighing not less than ten (10) tons until it has been thoroly compacted to a firm even surface. Rolling shall start longitudinally at the side and gradually proceed toward the center of the road-way, overlapping on successive trips by at least one-half the width of the rear wheel of the roller. During the process of rolling, the gravel shall be dragged, and the dragging and rolling shall continue until the gravel does not creep or wave under the weight of the roller.

If the gravel does not contain a sufficient amount of moisture to insure a proper bonding of the material, water shall be added by means of a sprinkling wagon, or other approved method, in a sufficient amount to obtain the desired results. The quantity used, and the time and method of application, shall be determined by the engineer in charge of the work.

Intermediate and Surface Courses. The intermediate and surface courses of gravel shall be constructed upon each compacted preceding course exactly as described for the base course above.

Depressions. Should any unevenness or depressions appear during or after the rolling, material shall be added or removed as may be required and the surface again watered and rolled until it is firm, smooth and uniform in character.

Measuring and Payment. The quantity of gravel road to be paid for shall be the number of square yards, measured horizontally, satisfactorily completed in accordance with the specifications. The price stipulated shall include shaping and rolling of the sub-grade and shoulders; furnishing, hauling, preparing and placing all materials, including gravel and binding materials; together with the spreading, shaping, harrowing, dragging and compacting and all labor and work incidental thereto, as set out in these specifications.

Work other than that provided in the contract and ordered by the engineer in writing, shall be paid for as agreed previously by contractor and engineer.

PROPOSED SPECIFICATIONS FOR GRAVEL ROADS

Description. On the sub-grade prepared as specified herein shall be constructed a gravel road of the cross-section and compacted thickness shown on the plans in accordance with these specifications.

Sub-Grade. The sub-grade shall be prepared and rolled with a ten (10) ton self-propelled roller until firm, hard and even and shall conform to the lines and grades and cross-sections as shown on the plans.

Where the sub-grade is unduly soft or clayey, a layer of gravel or cinders shall be placed thereon, in order to keep the sub-grade from working up thru the gravel, or there shall be constructed a series or system of underdrainage; the method to be used to be of such nature as to obtain the desired results and to be carried on under the direction of, and to the complete satisfaction of the engineer in charge.

Materials. The gravel shall be furnished by the contractor and shall be subject to approval of the engineer. It shall be composed of hard, sound, durable fragments of rock having uniform resistance to abrasion, together with fine material, such as sand, clay or other material approved as a binder by the engineer.

Physical Properties. The gravel shall meet the following requirements: (See Note 1). For surface course, the percent of wear not more than 15.

Grading. For Base or Intermediate Courses: When tested by means of laboratory screens, the gravel shall meet the following requirements:

	percent
Passing screen (See Note 2)	100
Passing ¼-inch screen, not more than	60
Passing 200-mesh screen, not more than	15

For Surface Course:

	percent
Passing 1½-inch screen	100
Passing ¼-inch screen, not more than	60
Passing 200-mesh screen, not more than	15

Note 1. Test to be made in accordance with method described in U. S. Department of Agriculture Bul. 949, Page 3.

Note 2. The maximum size of stone for any course shall not exceed three-fourths (¾) the depth of the course.

Construction.

Shoulders. During or after the preparation of the sub-grade and before any gravel is placed for any course, side forms shall be properly placed, and earth shoulders shall be built up against them along each side to a height equal to the thickness of each course. These shoulders shall be true to grade and of full width as shown on the plans. The shoulders may be built for both base and surface courses before any gravel is placed if so desired.

No material containing sod, weeds, roots or other deleterious matter shall be used in the construction of the shoulders.

Upon completion of the surface course, the shoulders shall be thoroly rolled and finished true to grade and cross-section as shown on the planns.

Base Course. Placing Gravel: The gravel of each course shall be spread uniformly by means of approved spreading wagons, or if dump wagons are used the material shall be deposited on platforms or in piles alongside the road, and shall be shoveled therefrom onto the sub-grade or preceding course. The larger stones shall be raked forward and evenly distributed over the subgrade and each successive course, so that they will be completely covered by fine material and not show on the surface.

CHAIRMAN HORNER: The next is the Report of Committee on Specifications for Brick Pavements, George F. Fisk, Chairman.

Secretary Brown read Mr. Fisk's Report, as follows:

REPORT OF THE COMMITTEE ON SPECIFICATIONS FOR BRICK PAVING

Your committee have carefully reviewed the new specifications for brick paving and have come to the conclusion that no changes should be made this year. There are two points in these specifications on which your committee is not fully agreed and on which they wish to send out questionnaires before fully deciding these questions.

Respectfully submitted,
E. A. Fisher,
Edward E. Duff, Jr.,
E. H. Christ,
George F. Fisk, *Chairman.*

Chairman Horner: Due to the fact that that Committee presented nothing for adoption, their report will simply be referred back to the next year's Committee. I will call for the next report of the Committee on Specifications for Cement-Concrete Pavements, Thomas J. Wasser, Chairman.

Secretary Brown read Mr. Wasser's report as follows:

REPORT OF COMMITTEE ON SPECIFICATIONS FOR CEMENT-CONCRETE PAVEMENTS

Your committee on specifications for Portland-Cement-Concrete Pavements begs to submit the attached report on the revision of the Portland-Cement-Concrete Pavement Specifications as presented October 14, 1920, and adopted by letter ballot January 5, 1921.

Respectfully submitted,
T. J. Wasser, *Chairman,*
W. D. Uhler.

Specifications for Portland-Cement-Concrete Pavements

Presented October 14, 1920, and Adopted by Letter Ballot, January 5, 1921. Recommended suggestions of your 1922 Committee on Specifications for Portland-Cement-Concrete Pavements as to changes in the Specifications presented October 14, 1920 and adopted by letter ballot January 5, 1921.

1. Material

1. Cement: As printed.

2. Fine Aggregate: Strike out the first eleven (11) lines and insert:

"Fine aggregate shall consist of natural sand, the particles of which are tough, hard, and durable. When dry they shall be uniformly graded, and all the product shall pass a screen having four (4) meshes per linear inch, not over 25 percent of which shall be retained on a screen having ten (10) meshes per linear inch. The grading shall be such as not more than 25 percent shall pass a screen having fifty (50) meshes per linear inch, and not more than 5 percent shall pass a sieve having one hundred (100) meshes per linear inch. Fine aggregate shall not contain organic or other deleterious matter, not more than 5 percent of clay or loam, and for determining organic or other deleterious matter, the colorimetric test shall be applied."

3. Coarse Aggregate: As printed.

4. Water: As printed.

2. Proportions

5, 6, 7, as printed.

8. Strike out both lines, and insert:

"The amount of water to be used shall be such that when testing concrete with the standard slump test, and allowed to remain exactly three (3) minutes, upon removal of the cone it shall slump not less than one and one half (1½) inches."

The balance of the specifications as printed.

Chairman Horner: Is there any one present who wishes to discuss the amendments offered by the Committee on Specifications for Cement-Concrete Pavements? There is one relating to fine aggregate, and one to slump test.

Mr. Gage: What does fine aggregate consist of?

The Secretary read the paragraph numbered 2 in the above report.

Mr. Gage: There must be an error in the printing of those specifications. According to the way it reads, twenty-five percent shall be retained, that means not less than twenty-five percent, I suppose. I think there must be an error in writing that, because I do not think they intended it that way.

SECRETARY BROWN: All products shall pass a screen having four meshes per linear inch, twenty-five percent of which shall be retained on a screen having ten meshes per linear inch.

MR. GAGE: I think they meant to have not over twenty-five percent less on the screen.

SECRETARY BROWN: Then it goes on to say that the grading shall be such as not more than twenty-five percent shall pass a screen having fifty meshes per linear inch.

MR. GAGE: I would like to make a motion that not more than twenty-five percent be retained on the screen.

The motion was seconded.

CHAIRMAN HORNER: I was going to suggest that the discussion be offered to the Committee in the way of a suggestion, and make it more definite before offering it next year. If that is satisfactory, we will let it stand that way.

(Chairman Wasser changed the reading to agree with the above by letter, explaining that it was a typographical error.)

CHAIRMAN HORNER: The next on the program is the Report of Committee on Specifications for Stone Block Pavements, R. A. MacGregor, Chairman.

SECRETARY BROWN: I believe Mr. MacGregor has made the statement that he will not be able to be here, and that there are no changes to offer this year.

CHAIRMAN HORNER: The next is Report of Committee on Specifications for Wood Block Pavements, E. R. Dutton, Chairman.

Mr. Dutton read prepared report as follows:

REPORT OF THE COMMITTEE ON SPECIFICATIONS FOR WOOD BLOCK PAVEMENTS

Since our last meeting in Baltimore we have endeavored to try out at least one of the suggestions for the work of the Committee, viz.: First, "See if it would be advisable to reduce the depth of the block when it is laid according to the present specifications for a bituminous cushion." We have laid a section of 2-inch wood blocks about 22 feet in length on a street in Minneapolis which carries quite a large traffic. These blocks were made of Southern Yellow pine 3 inches wide by 6 inches in length and 2 inches in depth treated with 16 pounds of creosote oil according to the American Society for Municipal Improvements specifications. These blocks were laid on a street which is paved with creosoted wood blocks and is of sufficient length to receive all the effects of the traffic. They were laid on a smooth-top concrete with a bituminous cushion and filler. The traffic on the street is largely motor traffic and a census taken August 16, 1922, on the street—Harmon Place at Maple Street—was as follows:

Horse-drawn vehicles	51
Motor trucks	765
Automobiles	9,772
Bicycles and motorcycles	99
Total	10,687
Heaviest 1-hr. traffic	1,106

The roadway on this street is 54 feet with two sidewalks 13 feet in width each, and is parallel with one of the principal arteries of the city—Hennepin Avenue—having car tracks, thereby diverting a very large amount of traffic to this street. Of course it is too short a time to tell anything about how these blocks will act, but time will tell and we can only find out by experience. Some of the manufacturers though it would be better to try a 2½-inch block, but if the wear on creosoted wood blocks was the determining factor, a 2-inch block would wear for years, as blocks that have been in use for over 20 years have not worn in excess of ¼ inch, so we decided to go the limit and see what a 2-inch block would do.

No action on the other two recommendations has been taken, but should be kept in mind and experiments made. The special pitch filler we used with a bituminous cushion has proven very satisfactory and we have had no complaints or observed any bleeding or sticky condition of the street. There are no recommendations to be made as to changes in the present specification. There has, however, arisen a question whether a change should not be made in Section 5 which provides for the sp. gr. of the fraction between 235° and 315° at not less than 1.03 and the fraction between 315° and 355° at not less than 1.10. In the changing of the manufacturing methods and the source of foreign supply of creosote oil there has been and is a lowering of the sp. gr. of these fractions so that an undoubtable coal-tar-creosote oil is on the market with a much lower sp. gr. for the fractions.

The American Wood Preservers' Association at its meeting in Chicago in January last discussed the feature quite thoroly and was of the opinion that there was genuine coal-tar creosote oil that would not pass the specifications, but did not recommend any changes, but endorsed a foot note to the cresosote specifications as follows: "Failure to meet the requirements of Sec. 5 shall not be a cause for the rejection of the oil, provided the seller can furnish satisfactory assurance as to coal-tar origin."

This leaves the matter pretty wide open, but the object of Sec. 5 is to obtain a coal-tar creosote, and if the present specifications restrict the use of undoubted coal-tar creosotes it should be taken into consideration.

We do not wish to change the specifications at this time but are giving this for the information of the Society, and persons using the specifications may take this into consideration, if they so desire, and permit the use of a lower gravity in those fractions without lessening or reducing the quality of the preservative properties of the oil.

ELLIS R. DUTTON, *Chairman*,
JOHN KLORER.

CHAIRMAN HORNER: This report requires no action by the meeting. Are there any questions that any one would like to ask Mr. Dutton? If not, the report will be received as read.

The next is Report of Committee on Specifications for Sidewalks and Curbs, H. A. Rowland, Chairman.

MR. ROWLAND: I do not believe the Committee has anything to offer at this time. No changes have been made.

CHAIRMAN HORNER: The next is Report of Committee on Specifications for Sewers, C. L. Howell, Chairman.

Mr. Howell read report as follows:

REPORT OF COMMITTEE ON SPECIFICATIONS FOR SEWERS

Your Committee on Specifications for Sewers at the last annual convention held in Baltimore, presented a complete tentative draft of the specifications for sewer materials and construction. These specifications were printed in full in the 1921 proceedings of the Society with a request for discussion by the members.

In order to initiate discussion copies of the tentative specifications for vitrified tile sewer pipe were sent to one hundred city engineers. Replies were received from about forty percent.

Copies of the tentative specifications for segmental tile block were sent to the best known manufacturers of this product. From the city engineers and the manufacturers much valuable information has been received.

No discussion, however, has been received from the members at large.

Your Committee was unable to get together during the year, but has carried on extensive correspondence.

Unfortunately, none of the members of your Committee, other than the chairman, are able to be in attendance at this convention.

Following the recommendations made in Baltimore, your chairman held open sessions on Monday and Tuesday evenings of this week.

The attendance at these sessions was representative and the honest criticism and open discussion cleared up many of the points at issue.

Letters received from three members of the Committee suggesting further consideration before final adoption were read at these open sessions.

In view of the above, we therefore respectfully recommend that these tentative specifications be referred back to the Sewer Specification Committee for further revision.

Respectfully submitted,

C. L. Howell, *Chairman.*

Mr. Howell: I would, therefore, move you that the recommendation of this Committee be adopted.

Chairman Horner: I know that this Committee has done exceptional work, and I believe in another year, the new specifications can be cleared up and offered for adoption.

The motion was seconded and carried.

Chairman Horner: The next is Report of Committee on Specifications for Sub-Grades and Foundations, Frederic A. Reimer, Chairman.

Mr. Reimer read prepared report as follows:

REPORT OF COMMITTEE ON SUB-GRADE AND FOUNDATIONS

At the St. Louis Convention in 1920 the Special Committee on Foundations for Pavements presented tentative specifications for old and new macadam base, asphaltic base, asphaltic concrete, tar bound base (cold penetration type), tar bound base (hot penetration type).

In 1921 at Baltimore amendments to these specifications were offered and printed in the proceedings as tentative. The Committee this year, after carefully considering the specifications as originally printed and amended, do now recommend their adoption as standard for the A. S. M. I.

The Committee also recommended that a specification for asphalt macadam base (penetration method) which has not heretofore been considered by the Society, be included as one of the standard foundations. We present the specifications for this type as prepared by the Asphalt Association, and recommend that same be printed in the proceedings and laid over for further consideration by the succeeding committee.

SPECIFICATION FOR ASPHALT MACADAM BASE

(Penetration Method)

Sec. 1. General Description

(a) The asphalt macadam base shall consist of two courses of mineral aggregate and asphalt cement combined as hereinafter specified and having a total compacted thickness of not less than six (6) inches. The bottom course shall have a compacted thickness of not less than three and one-half ($3\frac{1}{2}$) inches and the second course shall have a compacted thickness of not less than two and and one-half (2½) inches. The method of construction shall proceed substantially as follows:

I. A layer of No. 1 coarse aggregate rolled to the thickness of the bottom course shall be treated with hot asphalt cement as hereinafter specified.

II. A layer of No. 2 coarse aggregate shall then be laid, rolled to the thickness of the second course and treated with hot asphalt cement as hereinafter specified.

III. If a sheet asphalt or fine-graded-aggregate asphaltic-concrete surface course is to be laid directly upon the asphalt-macadam base, the surface voids in the base course shall be filled by applying and rolling in sufficient intermediate aggregate. The use of intermediate aggregate shall be omitted if an asphalt macadam, coarse-graded-aggregate asphaltic concrete or binder course is to be laid directly upon the asphalt-macadam base.

(b) All materials and methods of construction shall conform to the requirements of these specifications.

Materials

Sec. 2. Mineral aggregate (a) The mineral aggregate shall consist of broken stone, mine tailings or slag. It shall be of reasonably uniform quality thruout and shall be clean and free from dust and an excess of flat or elongated pieces. Rock or mine tailings from which it is produced shall have a percent of wear of not more than eight (8). Slag from which it is produced shall have a percent of wear of not more than ten (10) and shall weigh not less than seventy (70) pounds per cubic foot for each size specified.

(b) When tested by means of laboratory screens the coarse and intermediate aggregates shall meet respectively the following requirements and be uniformly graded between the limits given:

SIZE	NAME	PERCENT PASSING SCREEN				
		3½″	2½″	1¼″	1″	2″¾
inches						
2½–3½	No. 1 coarse aggregate..........	95–100	0–15			
1¼–2½	No. 2 coarse aggregate..........		95–100	0–15		
¾–1¼	Intermediate aggregate..........			95–100	25–75	0–15

Sec. 3. Asphalt cement The asphalt cement shall be homogeneous, free from water and shall not foam when heated to 175°C. (347°F.). It shall meet the following requirements for physical and chemical properties:

I. Specific gravity, 25°/25°C. (77°/77° F.), not less than. . 1.000
II. Flash point, not less than....................175°C. (347° F.)
III. Penetration at 25°C. (77° F.), 100 g., 5 sec..........80 to 150
(Between these limits the exact penetration within a 10-point range, if less than 90, or within a 30-point range if over 90, shall be as directed by the engineer)
IV. Ductility at 25°C. (77° F.), not less than.................30
V. Loss at 163°C. (325° F.), 5 hours, not more than. . .3 percent
Penetration of residue at 25° C. (77° F.), 100 g., 5 sec., as percent of original penetration, not less than. . .50 percent
VI. Per cent of total bitumen, soluble in carbon tetrachloride, not less than..................................99 percent

Sec. 4. Sources of supply. (a) Approval of sources of supply of mineral aggregate under these specifications shall be obtained from the engineer prior to delivery of material, and samples of each size specified shall be submitted as directed by the engineer.

(b) A one-pound sample of the asphalt cement that the contractor proposes to use in his work, together with a statement as to its source and character, must be handed in with his bid. No asphalt cement, other than that specified in his bid shall be used by any contractor except with the written consent of the engineer, and provided that the asphalt cement used shall comply in all respects with the requirements of these specifications.

Sec. 5. Methods of testing. Methods of testing shall be as follows:

(a) Percent of wear of rock, mine tailings, or slag, Standard Test D2-08, American Society for Testing Materials. When testing slag, 4000 c.c. loose measure of the size specified in the standard test shall be used.

(b) Weight per cubic foot of broken slag, Tentative Standard Method C29-20T, American Society for Testing Materials.

(c) Screen test of coarse and intermediate aggregates, Standard Method D18-16, American Society for Testing Materials.

(d) Physical and Chemical Properties of Asphalt Cement.

I. Specific gravity, U. S. Dept. of Agriculture, Bulletin 314, p. 5.
II. Flash point (open cup) U. S. Dept. of Agriculture, Bulletin 314, p. 17.
III. Penetration, A. S. T. M. Standard Test D5-16.

IV. Ductility, Trans. A. S. C. E., Vol. LXXXII, 1918, p. 1460.
V. Volatilization Test, U. S. Dept. of Agriculture, Bulletin 314, p. 19, using 50-gram sample.
VI. Bitumen soluble in carbon tetrachloride, U. S. Dept. of Agriculture, Bulletin 314, p. 30.

Construction

Sec. 6. Spreading and compacting coarse aggregate. (a) The No. 1 coarse aggregate shall be spread upon the prepared subgrade or sub-base course in a uniformly loose layer of correct thickness. Each load or pile shall be spread outside of the area upon which it is dumped, or by means of approved spreading wagons, in such manner that segregation of sizes is prevented and uniform compaction may be secured. Suitable precautions shall be taken to prevent the aggregate from becoming mixed or coated with dirt or other objectionable matter before and after spreading.

(b) The No. 1 coarse aggregate shall then be dry rolled with a power-driven roller, weighing not less than ten (10) tons. Rolling shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least one-half of the width of the roller. The compacted aggregate shall possess a firm even surface true to the grades and cross-sections shown on the plans, and present a texture which will allow of uniform penetration of the asphalt cement. If any irregularities appear during or after rolling they shall be remedied by loosening the surface and removing or adding No. 1 coarse aggregate, as may be required, after which the area disturbed, including the surrounding surface, shall be rolled until satisfactorily compacted to a uniform surface. All No. 1 coarse aggregate which becomes coated or mixed with dirt or foreign substances prior to the application of asphalt cement shall be removed and replaced with clean aggregate of the same kind, and compacted as specified.

Sec. 7. First application of asphalt cement. (a) Upon the rolled aggregate, hot asphalt cement shall be uniformly applied at the rate of from one and one-quarter (1.25) to one and one-half (1.5) gallons per square yard as directed by the engineer. Asphalt cement shall be applied only when the course is thoroly dry for its entire depth, and unless otherwise permitted by the engineer when the air temperature in the shade is at least 50°F. Application of the asphalt cement shall be made by means of a pressure distributer as described in paragraph (c) or with hand pouring pots as described in paragraph (d).

(b) The asphalt cement shall be heated in kettles or tanks designed to secure uniform heating of the entire contents and shall be brought to a temperature of 275°F. to 350°F. as directed by the engineer. The contractor shall provide all necessary facilities for determining the temperature of the asphalt cement during heating and prior to application.

(c) The pressure distributer used for applying asphalt cement shall be so designed and operated as to distribute the asphalt cement uniformly under a pressure of from 20 to 75 pounds per square inch, in the amount and between the limits of temperature specified. It shall be equipped with an accurate stationary thermometer in the tank containing the asphalt cement and with an accurate pressure gauge so located as to be easily observed by the inspector while walking beside the distributer. It shall be so designed that the normal width of application shall be not less than 6 feet, with provision for the application of lesser widths when necessary. In order to prevent lapping at the end junction of two applications, the distributer shall be promptly shut off when the application begins to thin just before the tank is emptied. Before continuing application with a new load of asphalt cement building paper shall be spread over the treated surface for a sufficient distance back so that the sprayers are operating at full force when the uncovered surface is reached. The building paper shall then be removed and destroyed. A narrow-spout pouring pot or hose attachment to the distributer shall be used to apply asphalt cement necessary to touch up all spots unavoidably missed by the distributer.

(d) Hand pouring pots used for applying asphalt cement shall have a capacity of not less than 3 gallons and shall be equipped with slotted spouts so placed that when the pot is emptied by carrying it forward with the end of the spout close to the road surface the width of application shall be not less than 8 inches. Each pot shall be fitted with a gage mark for accurately measuring the charge of asphalt cement before it is distributed. The distance to be covered by each charge shall be measured off and the pouring operation conducted so that the rate of application will be uniform as the pot is emptied. The direction of successive pourings shall be reversed. Application shall be made at such angle to the center line of the road, or longitudinally, as directed by the engineer. During pouring, the spout of the pot shall be kept within 6 inches of the surface of the road. The distributing slots shall be kept free from obstructions and shall be cleaned as necessary to insure a uniform distributing aperture. A narrow-spout pouring pot shall be used to apply asphalt cement necessary to touch up all spots unavoidably missed during the original application.

Sec. 8. Second course. Upon the bottom course prepared as previously specified No. 2 coarse aggregate shall be spread in a uniformly loose layer of compacted thickness rolled and treated with asphalt cement exactly as specified for bottom course except that if hand pouring pots are used for applying the asphalt cement the lines of distribution shall cross those of the first application at an angle of approximately 90 degrees.

Sec. 9. Filling surface voids with intermediate aggregate. If in accordance with Sec. 1, the surface voids are to be filled, after the application of asphalt cement to the second course and if practicable while it is still warm, a thin layer of dry intermediate aggregate shall be broad-casted over the treated surface in such quantity as to fill the surface voids and just cover the treatment. It shall then be broomed, if necessary, to break up all clumps and produce a uniform covering, after which the base shall be rolled until thoroly compacted and bonded. Suitable precautions shall be taken to prevent the distribution of intermediate aggregate over any portion of the coarse aggregate which has not received the first application of asphalt and in no case shall it be dumped directly upon either the treated or untreated coarse aggregate.

Sec. 10. Conditions prior to laying binder or surface course. Immediately before laying binder or surface course the base shall be cleaned of all loose or caked broken stone, dirt or other fine material so as to present a uniformly rough or granular appearance admitting of complete bond with the binder or wearing course.

IMPORTANT NOTICE TO ENGINEERS

These specifications are recommended for use under what may be termed average conditions. It is realized however that no single standard specification will satisfactorily cover all variations in local conditions which may prevail for individual jobs. Before adopting these specifications verbatim the engineer should therefore give particular consideration to the items listed below and if necessary make such changes as are suggested.

I. Thickness. These specifications call for a total finished thickness of base course of six (6) inches. If a different thickness is desired one of the following combinations is suggested.

(a). *Total thickness 7 inches.*

Sec. 1 (a) first sentence change *six* (*6*) to *seven* (*7*); second sentence change *three and one-half* (*3½*) to *four* (*4*) and *two and one-half* (*2½*) to *three* (*3*).

Sec. 1. (a) II. Insert *second* after first word, and strike out *No. 2*.

Sec. 2 (b) Table, strike out second line of requirements in connection with No. 2 coarse aggregate.

Sec. 8, strike out *No. 2*.

(b) *Total thickness 8 inches.*

Sec. 1 (a) first sentence change *six* (*6*) to *eight* (*8*). Strike out second sentence and insert. *Each course shall have a compacted thickness of not less than four* (*4*) *inches.*

Make all other changes as suggested above for total thickness of 7 inches.

II. Coarse aggregate. If only a very soft product with a per cent of wear greater than 8 is available, it is advisable to increase the thickness of the base to 7 or 8 inches and to make the changes recommended under *I. Thickness.* In addition the following changes should be made.

Sec. 2 (a) Strike out third and fourth sentences.

Sec. 5 (a) and (b) Strike out and change (*c*) and (*d*) to (*a*) and (*b*) respectively.

III. Use of crushed gravel. If it is desired to allow for the use of gravel in the construction of the asphalt macadam base the following sentence should be inserted after the first sentence in Sec. 2 (a). *If produced by crushing gravel only that portion of the gravel which has been retained upon a screen with three and one-half* (*3½*)*-inch or larger openings shall be used in its manufacture.*

IV. Asphalt cement. The most desirable consistency or "penetration" for asphalt cement will vary somewhat with climatic and traffic conditions. In Sec. 3 (a) III limits of penetration of from "80 to 150" are specified with a statement that between these limits the exact penetration within a 10-point range if less than 90, or within a 30-point range if over 90, shall be as directed by the engineer. The ranges of penetration suggested for various combinations of climate and traffic are shown in the following table.

TRAFFIC	TEMPERATURE		
	Low	Moderate	High
Light	120–150	90–120	80–90
Moderate	90–120	90–120	80–90
Heavy	80–90	80–90	80–90

V. Pressure distributer. The specifications provide for the application of asphalt cement either by means of a pressure distributer or by hand pouring pots. Both methods are satisfactory but if the engineer prefers to specify the use of a pressure distributer only, the following changes should be made:

Sec. 7 (a) last sentence, strike out *or with hand pouring pots as described in paragraph (d).*

Sec. 7 (d) Strike out.

Sec. 8. Strike out *except that if hand pouring pots are used for applying the asphalt cement the lines of distribution shall cross those of the first application at an angle of approximately 90 degrees*.

MR. REIMER: I move, therefore, that the specifications which were presented at the St. Louis Convention and printed in the proceedings for 1920, and modifications of these specifications which were made by this Committee at Baltimore and printed in the proceedings for 1921, be adopted and sent up for letter ballot.

CHAIRMAN HORNER: Is there a second to that motion?

The motion was seconded.

CHAIRMAN HORNER: Is there any discussion on the Committee's Report? If not, I will call for the question.

The motion was carried.

The vote on adoption of the specifications is reported on page 402 and the specifications will be found on page 390.

Chairman Horner: The next is Report of Committee on specifications for Street Railway Pavements, Including Track Construction, Charles E. DeLeuw, Chairman.

Secretary Brown: Mr. DeLeuw is not able to be present at this meeting. He was called away at the last moment. We have a telegram this morning stating that the Committee had not been able to meet for a discussion with the Committee of American Electric Railway Association, which they were instructed to have last year. The Committee of the American Electric Railway Association were not able to attend our Convention, because their Convention came on the same dates in Chicago. We are not able to attend theirs, with the exception of Mr. George, who is a member of this Society. He was here on Monday and Tuesday, and he will be in Chicago the remainder of the week, to take up with the Committee at Chicago the matters which were talked over here with several of us, including Mr. Maetzel, the Chairman of our Sub-Committee on Street Railway Construction. They will work out a set of specifications along the lines on which we have been talking.

Mr. DeLeuw, we hope, will be able to be in Chicago the latter part of this week and join in those discussions. At any rate, quite a bit of progress will be made this week in Chicago, and they expect to make a report next year, and I hope it will be published in the Advance Papers and be ready for action next year.

Chairman Horner: The next is Report of Special Committee on Standard Tests for Bituminous Materials, F. P. Smith, Chairman.

Mr. Smith read prepared report which is printed on page 73.

Mr. Smith: I move, Mr. Chairman, that the report of the Committee be received and accepted.

The motion was seconded and carried.

Chairman Horner: The next is Report of Special Commitee on Standard Tests for Non-Bituminous Paving Materials, A. H. Blanchard, Chairman.

Secretary Brown: I have a telegram from Mr. Blanchard, saying that he will be here tomorrow and Friday morning, and his report will probably be presented on Friday morning.

Chairman Horner: That ends the business of this session. We will adjourn our formal session until nine o'clock in the morning.

The meeting adjourned at three o'clock.

Thursday Morning, October 5, 1922

The session was called to order at nine o'clock, President E. S. Rankin presiding.

President Rankin: We are today somewhat unfortunate in that the authors of some of the papers are not here. I am going to call on Mr. Eddy to give us his paper at this time on "Use and Abuse of Separate Systems of Sewers and Drains." Mr. Eddy is a consulting engineer in the city of Boston.

Mr. Harrison P. Eddy read paper which will be found with discussion on page 128.

President Rankin: I will ask Mr. Langdon Pearse to give his report of the General Committee on Sewerage and Sanitation on "The Sewage Treatment Problems in the United States from the Standpoint of Sludge."

Mr. Pearse's paper is printed on page 78 and the discussion on page 126.

Vice-President Horner was called to the chair.

Chairman Horner: The discussion will be deferred until we have the full series of papers dealing with this subject. The next paper is the report of the Sub-Committee on Sanitation, T. C. Hatton, Chairman, on "Brief History of Sludge Dewatering Investigations at the Milwaukee Testing Station."

Mr. Hatton's paper is printed on page 96 and the discussion on page 126.

President Rankin resumed the chair.

President Rankin: The next paper is by Mr. H. B. Cleveland on "Centrifuging of Sewage Sludge."

Mr. Cleveland's paper is on page 108, and the discussion on page 126.

President Rankin: We have one more paper on the subject of sludge by Mr. I. P. Kane, on "The Fertilizer Value of Activated Sludge."

Mr. Kane: My paper constains considerable statistical data so I will read only a short summary of it.

Mr. Kane's paper in on page 113 and the discussion on page 126.

President Rankin: This concludes the papers on sludge and I will ask for discussion.

The discussion of the foregoing papers will be found on page 126.

Mr. Fisher: I move that the report of the Committee on Sewerage and Sanitation be accepted and the Committee continued.

The motion was seconded and carried.

President Rankin: At this time we think it best to defer the reading of any further papers for a short time and take up the business matters which have to be attended to this morning. The first is the election of officers for the ensuing year. Is the report of the Committee on Nominations ready?

Mr. Fisher: Your Committee on selection of officers for the ensuing year beg leave to submit the following report:

President, W. W. Horner,
First Vice-President, Ellis R. Dutton,
Second Vice-President, Herman H. Smith,
Third Vice-President, E. L. Dalton,
Treasurer, Robert Hoffman,
Secretary, Charles C. Brown.
Finance committee: C. A. Poole, H. E. Barnes, Harry L. Maier.

E. A. Fisher, *Chairman*,
G. W. Tillson,
W. A. Howell,
Frank R. Pierson,
E. A. Kingsley.

I bring this report to the convention and move that the report of the Committee be accepted.

The motion was seconded by Mr. Fuller and carried.

Mr. Hatton: I move that the nominations be accepted and the Secretary cast the entire ballot for these men.

The motion was seconded and carried.

PRESIDENT RANKIN: The report of the Committee on Place of Meeting is next. Mr. Compton is Chairman of that Committee.

SECRETARY BROWN: Mr. Compton left me a copy of his report in case he should be out at the time it was to be presented, and since he is not here, I will read it.

Invitations to hold our next Annual Meeting were received from the following cities:

Memphis, Tenn.
Louisville, Ky.
Washington, D. C.
Montreal, Canada
San Francisco, Calif.
Atlanta, Ga.

Delegations from Memphis and Louisville appeared before your Committee and furnished us full information regarding the facilities in each city for holding the 1923 Convention. Your Committee is very decidedly of the opinion that the next Convention should be held in the Middle Southwest, not only in view of the fact that various municipal activities are in progress in that section, but also in view of the fact that it is to the interest of the Society to increase our membership in that section. Your Committee is unanimously in favor of holding the 1923 Convention in Memphis, Tenn., and the Committee Chairman is instructed to recommend accordingly.

For the Committee,
R. KEITH COMPTON,
Chairman.

SECRETARY BROWN: Mr. Compton wished me to add that the city of Atlanta, at the suggestion of the Secretary, had withdrawn its desire for their invitation to be accepted this year, but wanted to be considered as having their invitation in for 1924, or 1925.

MR. CORSON: I move the report be received and accepted.

The motion was seconded.

PRESIDENT RANKIN: That will carry with it the adoption of Memphis for the next place of meeting.

The motion was carried.

Mr. Kingsley: Since the Committee received a number of letters from engineering associations here and in Canada, and also from Louisville, and in view of the fact that some of these were a little unusual in form and from the bodies from which they came, I move that the Secretary be instructed to reply to these splendid letters.

The motion was seconded and carried.

President Rankin: The next order of business is amendments to the constitution.

Mr. Tillson: The amendments were presented on the first day of the convention, two amendments.

The first one provided that the number of committees be left with the Executive Committee. In addition to that it gave the President power to nominate representatives of this Association to attend other meetings, which has been done by the President before, but always without any authorization.

I, therefore, move that that amendment be accepted and sent out for letter ballot.

The motion was seconded and carried.

Mr. Tillson: The other amendment was to the effect that engineers in charge of street railway construction, or in charge of public utilities of any kind, operated in streets or roads, be eligible for active membership in this Society. Heretofore, they have been affiliated members. The Executive Committee felt that the city engineers had so much to do with these other engineers, corporation engineers, in their work that it was only fair that they should be received into active membership. I, therefore, move that this amendment be approved by the Society and sent out for letter ballot.

The motion was seconded and carried.

Mr. Tillson: One other thing that seems to be in order as a matter of general business, and that is this: Yesterday afternoon the specifications for sheet asphalt pavement and bituminous pavement were accepted and ordered sent out for letter ballot. Since that time it has developed that there are certain differences in the specifications that ought not to be, and certain requirements in one that differ from those in the other.

I, therefore, move that we reconsider the matter on those specifications to be sent out for letter ballot with the idea of moving that they be referred back to their respective committees so that they may harmonize these differences and be the same before the next meeting.

Mr. Kingsley: I feel that we would be pretty wise in following almost any suggestion that Mr. Tillson might make. I learned that long before I became connected with municipal work. I have never yet seen any particular reason for deviating from what I learned a good many years ago. Consequently, I wish to second Mr. Tillson's motion.

As Chairman of the Asphalt Committee I will say that we worked quite hard on those specifications and felt pretty well satisfied with them, and yet, if it is for the benefit of the Association our Committee is perfectly willing to have them go back.

Mr. Collins: It has always seemed to me there was no occasion for having two committees on asphalt pavement. We have one Committee on sheet asphalt and another on asphaltic concrete and yet they are merely two variations of the same thing which, I think, should be handled by one Committee. Asphalt cement used in asphaltic concrete and sheet asphalt are the same in every respect except possibly in consistency, and like qualities.

President Rankin: If you will pardon me for interrupting, in accordance with the constitution I was obliged to appoint the two committees, but according to this amendment which we have just passed, or which will be passed by letter ballot, those two committees will be combined into one and get out one specification.

The motion is to reconsider the action taken at the meeting yesterday, as I understand it, in regard to the two specifications, one on asphalt pavement and the other on bituminous concrete pavements.

The motion was seconded and carried.

Mr. Tillson: I move that these reports be referred back to the respective committees so that they can harmonize these differences if there is not to be a single committee next year.

The motion was seconded and carried.

President Rankin: That will mean the new committee. The present committees expire with this meeting as I understand it.

I believe that concludes the business. We will now go on with our sewer papers, the first of which is a paper on "Recent Developments in Sewage Treatment," by George W. Fuller.

Mr. Fuller: This paper appears in Advance Papers. I am therefore not going to read it. I will call attention to a few of the higher places, perhaps, in order to refresh your memories and facilitate discussion.

Mr. Fuller's paper with such additional material as he presented is on page 151 and the discussion on page 191.

President Rankin: Before discussing Mr. Fuller's paper I will call for the other papers of a similar nature. The next one is a "General Review of One Year of Successful Operation of the Direct Oxidation Process of Sewage Disposal at Allentown, Pa.," by Harry F. Bascom.

Mr. Bascom's paper is on page 178 and the discussion on page 191.

President Rankin: I understand Mr. Hoffman has an announcement to make in regard to this afternoon's entertainment and I will take this opportunity to present to the city of Cleveland, thru him, this piece of statuary.

Mr. Hoffman: I am not sure that I can find a place in the parks, but I will see that it is preserved in the proper place.

Mr. Hoffman made announcement concerning afternoon's program.

President Rankin: We have a written discusion on this same question and I will ask the Secretary to read it.

Secretary Brown: This discussion is of Mr. Fuller's paper and Mr. Bascom's paper by Mr. George A. Johnson.

Mr. Johnson's discussion will be found on page 191.

President Rankin: There is another short written discussion.

Secretary Brown: This is by Mr. Hatton. He left this for me to present.

Secretary Brown read prepared discussion which will be found on page 196.

President Rankin: Mr. Gascoigne is down on the program for a paper, but he has asked me to excuse him from reading it as the time is getting somewhat late. He will be pleased to answer any questions in regard to the Cleveland Sewer System with Special Reference to the Purification Problem.

Mr. Bascom: Some comments have been made about the operation and the installation of the direct oxidation process at Allentown. I do not know that some of those who have made the comments have ever seen the plant or know very much about it except as they have been told.

We have with us Mr. Moerk, who has been in constant attendance, at least in the early days of its operation, and he wishes to say a word or two. He will confine his remarks to the subject and be very brief if you will permit it.

Mr. Moerk's discussion is on page 200.

President Rankin: I wish that we might continue, but I think we must call this discussion to a close.

This brings us up to our program as printed with the exception of the report of the Sub-Committee on Public Comfort Stations. This was printed in Advance Papers. The author, H. F. Bascom, was called for but had nothing additional to present.

The session adjourned at 1:30 p.m.

Thursday Afternoon and Evening

An automobile ride over the City of Cleveland on Thursday afternoon ended at Nela Park, the experimental station of the National Lamp Works, where the Convention were the guests at dinner and at the exhibit of the modern methods of lighting streets.

In the evening a session of the Convention was held under the auspices of the Committee on Street Lighting of which no stenographic report was made. The following papers were presented:

Report of the Committee on Street Lighting, C. W. Koiner, Chairman, City Manager, Pasadena, California. This report will be found on page 334.

Modern Requirements of Street Lighting, by T. W. Rolph, of the Holophane Glass Co., New York City and Newark, O. This paper will be found on page 351.

Notes on the Street Lighting of Greater Cleveland, by A. E. Suker, District Lighting Specialist, General Electric Company, Cincinnati, O. This paper will be found on page 372.

FRIDAY MORNING, OCTOBER 6, 1922

The session convened at nine o'clock, President E. S. Rankin presiding.

PRESIDENT RANKIN: The Report of Special Committee on Standard Tests for Non-Bituminous Paving Materials, which was to have been delivered on Wednesday, we will ask Professor Blanchard to give the first thing this morning.

Mr. A. H. Blanchard read prepared report and moved the adoption of the report.

The motion was seconded and carried.

The report will be found on page 75.

PRESIDENT RANKIN: I will now ask Mr. Blanchard to give us the report of the Committee on Traffic and Transportation.

Mr. Blanchard read the report with a number of interpolations, the entire report with additions and the discussion being printed on page 380.

On motion the report was received.

MR. BLANCHARD: It will only take just a moment to present to you the desirability of the American Society for Municipal Improvements becoming a corporate member of the Permanent International Association of Road Congresses, which is devoted to the efficient development of both highway engineering and transport, from the standpoint of street improvement as well as highways outside of municipalities. This International organization holds its Fourth International Congress, in Spain in May, 1923. Many of the prominent members of this Society have been appointed United States Reporters to that Congress.

The Association is one which, I believe, should be supported by our organization. Furthermore, we should be in a position to take an active part when the proposition comes to the forefront to hold the Fifth Congress, in 1926, in the United States.

The dues for corporate organizations are one hundred francs, which at the present rate of exchange is between $8 and $9.

I, therefore, move, Mr. President, that the American Society for Municipal Improvements become a corporate member of the Permanent International Association of Road Congresses.

The motion was seconded.

PRESIDENT RANKIN: Are there any remarks on the motion? I might say that the Society is at present represented in a number of different National Associations, and it seems to me that we should extend our field just as far as we possibly can. We have kept out of at least two on account of the expense, as you all probably know. We are not in a very flourishing condition financially, although we are improving every year since the war, but this expense is so slight it would seem to me that it would be a very vital thing to join.

The motion was carried.

PRESIDENT RANKIN: The next is Report of General Committee on Street Cleaning, Refuse Disposal and Snow Removal, A. P. Folwell, Chairman.

This report will be found on page 214.

PRESIDENT RANKIN: I will ask Mr. Baker to read Mr. Greeley's paper on "Modern Methods of Disposal of Garbage and Some of the Troubles Experienced in their Use."

The paper will be found on page 241.

PRESIDENT RANKIN: With your permission I am going to interrupt the regular program for a little while. We have here this morning Mr. Farnsworth who was scheduled to talk to us the other evening on the Metropolitan Park System of Cleveland. He was not present to carry out our regular program and since he has come this morning prepared to give us this talk, I am going to break the regular order.

I regret very much to have to announce that the moving picture machine operator will not be here this morning and Mr. Farnsworth will not be able to show his interesting motion pictures that he has prepared.

Manuscript for this paper was not presented for publication.

President Rankin: There has been a paper presented by Mr. Haff of New York on modern refuse disposal which he said would be all right if it was read by title and published in the proceedings. This we will do. The paper is on page 252.

REPORT OF COMMITTEE ON MEMBERSHIP

Your Membership Committee, which was appointed in the spring of this year, has carried on an active campaign since that time. The country was divided into twenty-five districts, which were represented by twenty-three members of the committee. The chairman of the committee has received individual reports from a majority of the committee members. These reports indicate that with the able assistance of the Secretary, who furnished detailed list of propects in each district and literature for mailing out, an average of 131 communications were sent out by each member. This would indicate that the whole committee has gotten in touch, through letters or personally, with some 3000 prospects in the United States and Canada. A number of the committee have sent to the chairman a copy of the personal letters sent out, all of which were exceptionally good.

The members of the committee in general are not in a position to advise as to the success of this campaign, as all the letters sent out requested replies and applications to be sent to the Secretary of the Society. From the applications received by the Secretary it is evident that the campaign has accomplished something even at this date, and there is no doubt that the publicity achieved will continue to show results thruout the coming year.

The committee recommends that a membership committee be appointed at the beginning of the next year, and that the work so auspiciously started be carried on without interruption.

Respectfully submitted,

W. W. Horner,
Chairman, Membership Committee.

President Rankin: We now come to the reports of representatives in other organizations.

American Engineering Standards Committee, Committee on Standard Tests for Penetration for Bituminous Materials, Mr. A. W. Dow. That report is here. If you will allow me I will read that report.

President Rankin read the prepared report of Mr. Dow as follows:

As you appointed me representative of the American Society for Municipal Improvements on the Engineering Standards Committee on Penetration, I am sending you herewith copy of a letter which I wrote in reply to a questionnaire from the Chairman of this Committee on May 31st. I did not send this to you at the time as I expected there might be other communications following, but I understand that the report of this Committee is to be made in time for the next Executive Meeting of the American Engineering Standards Committee, so I assume from this that there will be no further correspondence in the matter.

Very truly yours,
A. W. Dow.

May 31, 1922.

Mr. Thomas H. MacDonald, Chairman,
Special Committee on Penetration of Bituminous Materials,
American Engineering Standards Committee,
Office of Public Roads,
Washington, D. C.

Dear Sir.

I am in receipt of your favor of May 22 relative to the recommendation of the American Society for Testing Materials for the approval as a tentative American standard of its standard method of test for penetration of bituminous materials, D 5–21.

I note the various questions which you ask relative to this test and think that possibly a short history of it would be of value in answering them.

The penetration test for bituminous materials was first devised by H. C. Bowen. The first apparatus for making this test was constructed by him with my assistance in 1888. This apparatus consisted in a needle in the end of a lever arm. The lever arm was attached by a thread to a spindle, which, in revolving, turned a hand on a dial divided into 360 degrees. This apparatus is described in the School of Mines Quarterly, Vol. 10, 1889, page 297. It was patented by Mr. Bowen under U. S. Patent 494974. In this first apparatus no account was made of the distance penetrated by the needle, the distance being merely read off by degrees on the dial. It was found that when we tried to duplicate the apparatus it was impossible to get any two machines which read exactly alike at different penetrations. This was due to the variables in the length of the lever arm, the size of the spindle, and other factors which it would be very difficult to accurately duplicate.

Several years after this the writer recognized the difficulty of obtaining comparative results with different machines thruout the country and devised a new machine, a description of which is given in the Report of the Operations of the Engineer Department of the District of Columbia for the year ending June 30, 1898, page 127. In this new apparatus the writer adopted the following standards:

The distance in penetration expressed in hundredths of a centimeter with a number 2 needle, acting under 100 grams for 5 seconds at 77°F. The Roberts No. 2 needle was selected, as we found by experimenting with various No. 2 needles, that they were the most uniform in size.

This apparatus consisted in a hollow aluminum tube, with the needle inserted in the end, which could be brought to any desired weight by the addition of mercury. The penetration was made by allowing the needle to penetrate into the sample under the weight of the tube, which was held in a vertical position by guides in a frame work. This machine gave very concordant results and was very satisfactory so long as the aluminum tube was kept polished and clean in order to prevent any friction between it and its guides.

In 1900 the writer conceived the idea of doing away with the slight objection to the tube penetrating down thru guides, by devising an apparatus in which the center of gravity would be below the point of the needle so that when the needle and its rod were released it would stand perpendicularly on the point of the needle. This apparatus is described in the Report of the Operations of the Engineer Department of the District of Columbia for the year ending June 30, 1901, page 158. This apparatus is still in use and many thousands of tests have been made with it in the paving industry. I would say that there are over 2,000 machines now in use for this test, using the above standards. Committee D-4 of the American Society for Testing Materials have done considerable collaborative work on this test and have found that if operators follow explicitly the standard directions, results are obtained varying not more than 4 per cent.

We have naturally had a great deal of experience with this test in our line of work and have acted as referees in many cases. In every case where two operators have been brought together and the tests have been made under identically the same condition on the same material, even closer concordance has been obtained than 4 per cent.

I believe that this short history will answer your questions A, B and C.

As to questions D and E, relative to the appointment of a sponsor or sponsors and a sectional committee for the consideration of this test, I believe such sponsors and committee would be most desirable and would recommend that the Chairman of the Special Committee be empowered to appoint a sponsor or sponsors and a sectional committee for consideration of this test.

Yours truly,
A. W. Dow.

President Rankin: Next is National Safety Council on Colors for Traffic Signals, E. R. Dutton, representative, and F. A. Reimer, alternate. As Mr. Reimer attended the meeting the report is from him.

At the request of President Rankin, I attended the Conference on Colors for Traffic Signals held in New York City on May 23 this year. I attended this conference in the capacity as an alternate for Mr. E. R. Dutton, who had been appointed by President Rankin, but was unable to attend.

The Conference had been called by the American Engineering Standards Committee of which Mr. A. W. Whitney is Chairman and the subject of the Conference was the Standardization of Colors for Traffic Signals. There were in attendance forty-nine representatives of thirty-four National Organizations, also representatives of eight States and Cities, and twenty-five representatives of fourteen manufacturers of signal devices. Several of the important New York papers were also represented.

The meeting was called to order by Mr. A. W. Whitney, who briefly outlined the purpose of the Conference. Dr. C. H. Sharp, of the Illuminating Engineering Society, spoke on the considerations which led up to the request for the calling of the Conference. Dr. John H. Harris, of the New York City Police Department, spoke briefly and assured the meeting that his Department would coöperate and give its hearty support to bringing about the Standardization of Color Signals. Mr. A. H. Rudd, representing the American Railway Association, presented a paper summarizing the general facts affecting the steam railways and made suggestions concerning standardization progress. Mr. H. B. Flowers, representing the American Electric Railway Association, presented a paper in reference to electric railway signals. Mr. A. L. McMurty, of the Motor Vehicle Administrators, spoke of their interest in the work and assured the Conference of their full coöperation. Mr. R. J. Durley, Secretary of the Canadian Engineering Standards Association, spoke at considerable length on the question and hoped that the conclusions reached would assure substantial uniformity both in the United States and Canada. After further discussion by several representatives of other organizations the following was adopted as the scope of the work for future consideration.

The use of colored lights on all highway vehicles.

Their use on all signals along highways and at curbs, both permanent and temporary.

Their use for highway crossing signals for steam and electric railways.

A coördinated relation of color, form, position and number of signals.

A coördinated relation to systems of flashing, moving or other similar lights.

Colors for non-luminous as distinguished from luminous signals.

Recommendations on the use of colors for emergency exit signals.

Methods of specifying or defining colors for signals purposes.

Any other closely related matters which, in the opinion of the sectional committee, form a part of the subject to be considered.

On further motion the following resolutions were adopted.

(a) *Resolved:* that it is the sense of this Conference that in carrying out its recommendations, any sectional committee which takes up the standardization of colors for signals should endeavor to coördinate such standardization with existing standards for traffic purposes, such as used in water and aerial navigation and on steam and electric railways.

(b) *Resolved:* that the detailed technical work should be carried out by a thoroly representative sectional committee under the auspices and procedure of the American Engineering Standards Committee.

(c) *Resolved:* that the recommendations of the Conference be transmitted to the American Engineering Standards Committee without definite recommendations on sponsorship.

The above report is presented without any recommendations.

FRED A. REIMER,
Special Representative, American Society for Municipal Improvements.

PRESIDENT RANKIN: Next is the three committees on street railway appliances. I believe there have been no meetings of those committees. They were only recently appointed.

International Engineering Congress at Rio De Janeiro. I appointed one of our members who lives in Brazil. Of course, that Congress is still in session so that we have no report from there.

The report of the Paving Brick Committee of the U. S. Department of Commerce by Mr. Fisk is here and I think possibly it would be well to read that.

Secretary Brown abstracted the report which follows:

August 15, 1922.

Your representative on Committee C-3 on Paving Brick, American Society of Testing Materials, respectfully submits the following report:

At the annual meeting of Committee C-3 on Paving Brick A.S.T.M. held at Atlantic City June 26–30, 1922, the following actions were taken:

The Committee recommended that the action of the Conference on Elimination of Unnecessary Sizes and Types of Paving Brick of the Department of Commerce reducing the former 66 sizes and types of paving brick to 11, be formally approved by the Society:

The Tentative Specifications for Clay Sewer Brick were discussed at length and several changes seem desirable, but as the discussion is still in active progress it seemed inadvisable to make any changes at this time and the Committee, therefore, recommended that these specifications be continued without change as tentative for another year.

Tentative Specifications for concrete brick were prepared by a sub-committee of which Committee your representative is a member, but their approval by Committee C-3 was lost by a vote of 10 to 12. This action by the members of the Committee was apparently prompted by a desire for further information about concrete brick and further time to study the proposed specifications. The specifications were, therefore, referred back to the sub-committee.

Committee C-3 is now organized to prepare specifications for sewer brick of material other than clay should the need for such specifications arise.

Your representative has been appointed Chairman of Sub-Committee 4 on Paving Brick and as such recommended the adoption of the seven sizes and types of paving brick selected by conferences of the Department of Commerce.

Respectfully submitted,

Geo. F. Fisk.

August 18, 1922.

Your representative at the Conference on Elimination of Excess Variety and Standardization of Vitrified Paving Brick held at Washington, D. C. Nov. 15, 1921 and March 27, 1922 herewith respectfully submits the following report:

I wish to emphasize the fact that the types and sizes recommended by this Conference should be referred to as the "recognized types and sizes" and not as the standard sizes.

Abstract of minutes of the meeting of the permanent committee known as the Committee on Simplification of Variety and Standards for Vitrified Paving Brick of the Department of Commerce created for the purpose of making such other eliminations as time goes on as shall be mutually acceptable to producer and consumer.

In response to an invitation the following delegates were present, representing manufacturers, architects, engineers and the Government departments:

American Association of State Highway Officials. L. C. Herrick, Dir, Highways and Public Works, State of Ohio, Columbus, Ohio.
American Ceramic Society. Ross Purdy, Organizing Secretary, Columbus, Ohio.
American Electric Railway Engineering Association. Francis Ringley, Way Committee, Washington, D. C.
American Engineering Council. R. Keith Compton, Chairman & Consulting Engineer, Baltimore Paving Commission, Baltimore, Md.
American Engineering Standards Committee. A. S. McAllister, Secy., 29 W. 35th St., New York.
American Institute of Architects. Leroy E. Kern, 19 W. 44th St., New York, N. Y.
American Institute of Mining and Metalurgical Engineers. Oliver Bowles, Bur. of Mines, Washington, D. C.
American Society of Civil Engineers. W. B. Uhler, Chief Engineer, Pennsylvania State Highway Department, Harrisburg, Pa.
American Society for Municipal Improvements. Geo. F. Fisk, Chairman, Brick Paving Committee, Room 20 Municipal Bldg., Buffalo, N. Y.
American Society for Testing Materials. Warren E. Emley, Secretary, Committee C-3, U. S. Bureau of Standards, Washington, D. C.
Columbus (O) Engineers Club. R. C. Watts, Hartman Bldg., Columbus. Ohio.
Federated American Engineering Societies. L. W. Wallace, Ex-Secretary, 719–15th St., Washington, D. C.
Indiana Engineering Society. W. P. Blair, Engineers Bldg., Cleveland, Ohio.
United States Chamber of Commerce. E. W. McCullough, Mgr., Fabricated Production Dept., Washington, D. C.
Western Society of Engineers. John A. Dailey, Dept. Public Works, Chicago, Ill.
Government Departments:
    Bureau of Standards, Dr. F. C. Brown, P. H. Bates, Messrs. Harriman and Taylor.
    Department of Agriculture, Bureau of Public Roads, P. St. J. Wilson, Chief Engr.
    Department of Commerce, F. M. Feiker, Assistant to the Secretary.
    Department of the Interior, Bureau of Mines, L. I. Shaw, Assistant Chief Chemist.
    Navy Department, Bureau of Yards and Docks, Lt. Richard H. Gifford.
    War Department, Major H. L. Green.

Engineers:
- Herbert M. McCullough, Consulting Architect, Dunn Wire-Cut Lug Brick Co.
- Harry McCreary, Road Engineer of Florida.
- E. J. Mehren, Editor, Engineering News-Record.
- Harry T. Shelley, Chief Engineer, Eastern Clay Products Asso.
- Geo. W. Tillson, Cons. Engr. Dunn Wire-Cut Lug Brick Co.
- James C. Travilla, Cons. Engr. Dunn Wire-Cut Lug Brick Co.

Paving Brick Industry:
- N. P. B. M. A. Committee on Elimination of Excess Variety.
  - C. C. Barr, Barr Clay Co., Streator, Ill.
  - S. M. Duty, Medal Pav. Brick Co., Cleveland, Ohio.
  - R. T. Hutchins, Mack Mfg. Co., Wheeling, W. Va.
  - O. W. Renkert, Metropolitan Pav. Brick Co., Canton, Ohio.
  - M. B. Greenough, N. P. B. M. A., Cleveland, Ohio.
- Others:
  - G. O. Bowles, Mack Mfg. Co., Wheeling, W. Va.
  - Frank Dunn, Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio.
  - J. W. Hall, Westport Paving Brick Co., Baltimore, Md.

In opening the conference F. M. Feiker, Assistant to the Secretary, read a copy of the invitation and in concluding his remarks stated that the Paving Brick Manufacturing Association had made a very complete and exhaustive study of the sizes and varieties of paving brick, and that the purpose of the conference was to bring together the representatives of the manufacturers, of engineers, and all those who had any specifying or buying relations to this problem, and to discuss it from the point of view of eliminating excess sizes and varieties.

A copy of the report showing 66 sizes and varieties of the Paving Brick Manufacturers' Association was presented to each member.

E. W. McCullough, Manager of the Fabricated Production Department of the U. S. Chamber of Commerce, was asked to preside as Chairman.

Secretary Hoover, addressing the conferees gave a clear and comprehensive statement of the necessity of action on the matter under consideration.

Upon completion of Secy. Hoover's remarks the report of the National Paving Brick Association was read by M. B. Greenough, Secretary, National Paving Brick Association. This report contained an exhibit of the tabulation of the actual shipments of vitrified paving brick of 66 varieties from 1914 to August 1, 1921.

Upon motions duly seconded and unanimously passed the conference thru a process of elimination, using as its basis a maximum size of brick 4″ (depth) x 3½″ (width) x 8½″ (length) and as a minimum 3″ (depth) x 3″ (width) x 8½″ (length) reduced the varieties for consideration from 66 to 20, as follows:

DEPTH	WIDTH	LENGTH
Plain Wire-Cut (Vert. Fib. Lugless)		
inches	*inches*	*inches*
3	4	8½
3½	4	8½
Repressed Lug Brick		
4	3	8½
3	3½	8½
3½	3½	8½
4	3½	8½
Vertical Fiber Lug Brick		
3	4	8½
3½	4	8½
Wire-Cut Lug Brick (Dunn)		
3	3½	8½
3½	3½	8½
4	3½	8½
Special brick Hillside Brick (Dunn)		
3½	3½	8½
4	3½	8½
Hillside Brick (Repressed)		
4	3½	8½
Street Railway Brick		
3	3	8½ (Fillers)
3	3½	8½
4	3½	8½
4	3½	8½ (Stretchers)
Miscellaneous		
4	3¼	8½ (End cut)
4	3¼	8½

As considerable debate ensued concerning further elimination; it was decided by motion to appoint a committee for the purpose of considering the remaining 20 varieties, said committee to present its report immediately following the reconvening of the afternoon session.

Chairman appointed the following named as a committee of five: F. B. Dunn, Leon C. Herrick, P. H. Bates, O. W. Renkert and E. J. Mehren, Chairman.

At 2.30 P.M. the conference was called to order by the Chairman and the following report of the committee was read and unanimously adopted.

Your Committee has discussed the further elimination of sizes as directed by the conference this morning. In approaching the subject the committee considered it desirable, if possible, to so reduce the number of sizes that all brick could be cut out of two clay columns, one 3 inches and the other 4 inches high.

On consideration, it felt that the present demands are such that there must be placed at the disposal of engineers brick to make a wearing surface either 3, 3½ or 4 inches in depth. In the smaller cities a 3-inch pavement is wanted. The larger cities require a 4-inch brick. The State Highway Departments, on the other hand, find 3-inch too shallow for their traffic and 4-inch deeper than necessary and are therefore going to a 3½-inch depth.

With these three depths considered imperative, the committee deems it desirable to eliminate only nine of the varieties over and above those eliminated this morning.

Some explanation of these eliminations is called for: A 4 x 3 x 8½″ brick was eliminated even though a fairly large number of that variety is used, because no hardship is imposed by asking the substitution of a 4 x 3½ x 8½″, a brick of equal depth but ½ inch wider. No freight is saved on the 4 x 3 x 8½″ over 4 x 3½ x 8½″.

A 3 x 3½ x 8½″ brick was eliminated simply because it has never been widely used and, even tho it is the only repressed size with which a 3-inch pavement can be built, the committee believes that it would be a mistake to artificially encourage its use by naming it as a standard.

Coming to the eliminations in the various classifications of special brick, the committee has gone on the principle that all these varieties should be eliminated as standard in so far as possible. Looking to the wide use of the Hillside type, however, it has deemed this use sufficiently important to retain one size.

in each of the Hillside classifications, that is to retain only the 4 x 3½ x 8½″ in Dunn Hillside Brick and, as decided this morning the 4 x 3½ x 8½″ in the repressed Hillside. In other words from these classes the 3½ x 3½ x 8½″ is eliminated by the Committee.

All other specials should be in the nonstandard class.

With these eliminations—that is, both these made this morning and those here recommended—the number of standard varieties would be 11, and the number of sizes 4, to wit:

WIDTH	DEPTH	LENGTH
inches	*inches*	*inches*
3½	4	8½
3	4	8½
3½	3½	8½
3½	3	8½

The varieties, therefore, that would be retained are as follows:

WIDTH	DEPTH	LENGTH
Plain Wire-cut Brick (Vert. Fiber Lugless)		
inches	*inches*	*inches*
3	4	3½
3½	4	8½
Repressed Lug Brick		
3½	3½	8½*
3½	4	8½
Vertical Fiber Lug Brick		
3	4	8½*
3½	4	8½*
Wire-Cut Lug Brick (Dunn)		
3½	3	8½
3½	3½	8½
3½	4	8½
Hillside Lug Brick (Dunn)		
3½	4	8½*
Hillside Lug Brick (Repressed)		
3½	4	8½

* Eliminated at meeting of March 27, 1922.

The committee believes that further reduction of varieties is desirable, but that this should follow after further study and after the idea of standardization in vitrified paving brick sizes has become well impressed on the paving field. To go too far at the start is likely to arouse such strenuous opposition as to defer for a protracted time the good results which are desired from this conference.

F. B. Dunn,
Leon C. Herrick,
P. H. Bates,
O. W. Renkert,
E. J. Mehren, *Chairman.*

Following the adoption of the committee's report the question as to the usual variations incident to the manufacture of brick was discussed at length. In order to avoid the necessity of being held to exact dimensions, the following resolution was adopted:

> The sizes stated in this report are to be regarded as nominal and subject to the usual variation of $\frac{1}{8}$ inch in width and depth, and $\frac{1}{2}$ inch in length.

The necessity of invoking a follow-up system to insure the adoption of the standardization embodied in the resolutions of the conference; to effect a greater degree of contact and cooperation between the Department of Commerce and the various organizations and manufacturers incident to the paving brick industry, and to consider further eliminations in the existing varieties of brick was recognized and a committee of 10 were appointed for that purpose as follows: W. D. Uhler, American Society of Civil Engineers; Leon C. Herrick, American Association of State Highway Officials; Geo. F. Fisk, American Society for Municipal Improvements; Wm. P. Blair, American Society for Testing Materials; Col. R. Keith Compton, Federated American Engineering Societies; Maurice B. Greenough, National Paving Brick Manufacturers Association; E. W. McCullough, Chamber of Commerce, U. S. A.; Vernon M. Peirce, Bureau of Public Roads; W. A. Hull, Bureau of Standards; Wm. A. Durgin, Department of Commerce.

A meeting of this committee was held at Washington, D. C. on March 27, 1922, to consider further eliminations.

The following members being present: Blair, Wm. P., American Society for Testing Materials; Compton, Col. R. Keith, Federated American Engineering Societies, American Society for Municipal Improvements; Greenough, Maurice B., National Paving Brick Manufacturers Association; Herrick, Leon C., American Association of State Highway Officials; McCullough, E. W., Chamber of Commerce of the U. S. A.; Mehren, E. J., Engineering News-Record; Peirce, Vernon M., Bureau of Public Roads, Dept. of Agriculture; Hull, W. A., Bureau of Standards, Dept. of Commerce; Durgin, Wm. A., Division of Simplified Practice, Dept. of Commerce.

In addition to members of the committee the following were also present: Travilla, James C.; Tillson, Geo. W., Dunn Wire-Cut Lug Brick Co.; Marker, James P., Ohio Paving Brick Manufacturers Association; Love, H. J., National Slag Association of Cleveland, Ohio; Holden, Paul E., Chamber of Commerce of the U. S. A.; McAllister, A. S., American Engineering Standards Committee; Hudson, Ray M., Wilhelm, Donald, Division of Simplified Practice, Dept. of Commerce.

Mr. Durgin stated that out of requests for acceptances of Simplified Practice Recommendation No. 1 sent to 69 paving brick manufacturers and 11 associations, 46 and 9 respectively had accepted.

Five Federal Departments have also accepted; American Association of State Highway Officials; American Ceramic Society; American Institute of Architects; American Society of Civil Engineers; Eastern Clay Products Association; also Engineers Club of Columbus, Ohio; National Paving Brick Manufacturers Asso.; Western Society of Engineers; Department of Agriculture; Department of Commerce; Department of the Interior; Navy Department; War Department; Indiana Engineering Society.

Mr. Greenough reported the results of a new survey made by his Association of shipments of brick during 1921. The results are tabulated as follows, showing the percentage of shipments of each class named.

	1921 TO AUGUST 1	1921 COMPLETE
	per cent	*per cent*
Plain Wire-Cut Brick (Vert. Fiber Lugless).....	42.8	44
Repressed Lug Brick........................	25.4	27
Vertical Fiber Lug Brick......................	9.8	1.0
Wire-Cut Lug Brick (Dunn).....................	20.2	21
Special Brick..................................	1.7	6.68
Unclassified....................................	0.1	0.2
	100.0	99.98

Mr. Greenough also reported that the members of the Manufacturers Association had expressed their preference for each of the eleven varieties of paving brick, a capacity of 3,562,000 tons voting. The results are as follows:

TYPE			SIZE	TONS VOTING TO RETAIN	PER CENT
1	"a"	Plain Wire-Cut	3 x 4 x 8½	3, 532, 000	99
4	"b"	Repressed Lug	3½ x 4 x 8½	1, 892, 000	53
9	"c"	Wire Cut Lug	3½ x 4 x 8½	1, 807, 000	51
2	"d"	Plain Wire-Cut	3½ x 4 x 8½	1, 802, 000	51
10	"e"	Repressed Hillside	3½ x 4 x 8½	1, 647, 000	46
5	"f"	Vertical Fiber Lug	3 x 4 x 8½	1, 021, 000	29
6	"g"	Vertical Fiber Lug	3½ x 4 x 8½	946, 000	27
7	"h"	Wire-Cut Lug	3½ x 3 x 8½	865, 000	24
11	"i"	Wire-Cut Lug Hillside	3½ x 4 x 8½	586, 000	16
8	"j"	Wire-Cut Lug	3½ x 3½ x 8½	576, 000	11
3	"k"	Repressed Lug	3½ x 3½ x 8½	321, 000	9

Mr. Durgin forcibly stated that the Department could not, and would not approve, or sanction a recognized size or type decided upon by divided vote. The following sizes, therefore, were eliminated from the 11 varieties under consideration by unanimous vote of the Committee:

MOVED BY	SECONDED BY	STYLE	SIZE
M. B. Greenough	Col. R. Keith Compton	Vert. Fiber Lug	3 x 4 x 8½
M. B. Greenough	Col. R. Keith Compton	Vert. Fiber Lug	3½ x 4 x 8½
M. B. Greenough	Leon C. Herrick	Wire-Cut Lug Hillside	3½ x 4 x 8½
W. A. Hull	Col. R. Keith Compton	Repressed Lug	3½ x 3½ x 8½

The following actions were adopted:

Moved by Mr. Herrick and seconded by Col. Compton that the action taken at this meeting would be considered final as the expression of the Standing Committee.

Moved by Mr. Blair and seconded by Col. Compton that there shall be no further consideration of elimination of varieties until March 1923, and that preceding such consideration of elimination the views of the manufacturers will be consulted.

Moved by Mr. Greenough and seconded by Col. Compton that the official method of referring to the types and sizes as recommended by this committee be—"recognized types and sizes."

Respectfully submitted,
GEO. F. FISK,
Member Standing Committee of Vitrified Paving Brick Conference,
United States Department of Commerce.

PRESIDENT RANKIN: American Construction Council. Mr. R. K. Compton was the delegate to this meeting. We have his report here and the Secretary will read it.

Report on Organization of the American Construction Council at Sessions held June 19 and 20, 1922, Washington, D. C.

To the President and Members:

On June 6, 1922, your President appointed the writer a delegate to attend the organization meetings of the American Construction Council, in Washington, D. C., June 19 and 20, and he had the pleasure of attending both sessions.

The opening meeting was addressed by the Hon. Herbert Hoover, Secretary of Commerce. Mr. Hoover was followed by prominent engineers, architects and builders from various parts of the country, each of whom laid particular emphasis on his particular line of work pertaining to the building industry. At the final session on June 19, Mr. Franklin D. Roosevelt, of New York City, former Assistant Secretary of the Navy, was elected president.

There is attached hereto a full list of the officers and members of the Executive Committee, the Executive Committee being divided into groups from 1 to 11, including each profession and every line of interest pertaining to building and construction work.

At a subsequent meeting of the Executive Board, held at the home of Mr. Roosevelt in New York, a program to promote coördination among construction industries, looking to the elimination of waste, over- or under-production in building material, and the elimination of labor shortage or unemployment on a large scale, was promulgated.

Included in the program adopted for the first year's work of the council was the drafting of a code of ethics to restore public confidence in the building industries, shattered to a great extent thru disclosures in this country in the last two years. The program will be chiefly along the following lines:

A. To strike at what perhaps is the fundamental evil in the construction industry—the lack of steady employment on the part of three million workers.

B. To promote vocational guidance thru the educational systems of the country, in order to raise the efficiency and workmanship and to coöperate with labor in effecting a reduction in the national shortage of skilled building mechanics and encouragement of proper apprenticeship systems.

C. To appoint immediately a committee to formulate a code of ethics governing all branches of the construction industry, to promote greater public confidence, and to eliminate various abuses from which both the public and the industry have suffered.

The problem involved in the lack of steady employment in the construction industries received considerable attention at the Washington meeting, and the matter of seasonable employment was dealt with very minutely by several of the speakers.

There is attached hereto a copy of the by-laws as practically adopted at the Washington meeting (not reproduced). It will be noted that under Article III, Membership, paragraphs 1 and 2, there shall be two classes of members, association and sustaining. All national associations in the construction industry shall be eligible to association membership, and each will then be assigned by the Executive Board to its particular group.

It will also be noted that under Article IX, Dues, paragraph 2, "The Annual dues for each association member shall be $100.00." Undoubtedly, the American Construction Council has undertaken work in a very wide field and in a very broad manner, and its effort to stabilize the construction industry in this country will receive the full sympathy and coöperation of the American Society for Municipal Improvements. The matter of .expense, however, is quite an item to this society at this time.

The report is therefore submitted for your consideration.

Respectfully submitted,
R. Keith Compton.

Secretary Brown: It is desired to present this report to the Society and to get the opinion of the Society as to whether we should join the organization or not, in case we can take care of the subscription price.

President Rankin: Does any one care to make any motion on this matter? I am afraid, Mr. Secretary, that we are hardly in position this year to spend $100 on that. It would seem to me that it would be as well to lay it over for the consideration of the incoming Executive Committee. If there are no objections, this will be done.

This concludes the business with the exception of the report of the Committee on Resolutions. I will ask the Secretary to read them.

Resolved that the National Lamp Works of Cleveland and Mr. E. A. Anderson, Illuminating Engineer be given a vote of appreciation for the very delightful entertainment given the members and guests attending the Twenty-Eighth Annual Convention of the American Society for Municipal Improvements.

Resolved that the American Society for Municipal Improvements hereby express its appreciation of the welcome to the city of Cleveland given by his honor, Mayor Kohler and of the many courtesies shown to the members and guests attending the Twenty-Eighth Convention by the several city officers and citizens; and be it further

Resolved that special thanks be extended to Mr. Robert Hoffman, Chairman and his coworkers of the General Convention Committee and to Mr. Maurice B. Greenough, Chairman and his coworkers of the Exhibit and Entertainment Committees for the complete arrangements made for the reception and entertainment of the members and guests attending the Convention.

Resolved the the Directors and employees of the Art Museum of the city of Cleveland be given a vote of thanks for the many courtesies extended to the members and guests attending the Twenty-Eighth Convention of the American Society for Municipal Improvements and particularly for the delightful tea tendered to the ladies.

Resolved that the American Society for Municipal Improvements hereby expresses its thanks to the Cleveland Section of the American Association of Engineers for so kindly placing the sight-seeing car at the disposal of the ladies attending the Twenty-Eighth Annual Convention.

Whereas at a Convention of the American Society for Municipal Improvements held at Cleveland, Ohio, October 2nd to 6th, 1922, attention was called to the fact that in many sections of the country road building and street construction have been and are now being hampered by reasons of the inability to obtain material, where rail haulage is required,due to the shortage of cars.

Resolved that the Interstate Commerce Commission be requested to give urgent consideration to the correction of this situation, so that this season's road building program may be completed, as it is of primary importance to the community life of the nation and only secondary to the distribution of coal and other necessities of life.

The resolutions were adopted as read.

PRESIDENT RANKIN: I want to say before adjourning this convention how much I have appreciated the uniform courtesy with which you have treated me and the assistance which all of the members have given me in my attempt to lead you thru this convention and thru the past year.

It has been an inspiration to me to be at the head of a body of men of the character which composes the membership of this Society. I have enjoyed it all. I am glad to have had the opportunity but I am also glad that the President's term is for only one year, and I am particularly glad at this time to be privileged to turn over the gavel to a man who I know will lead you to success thru the coming year, my good friend Mr. Horner. Mr. Horner, will you take the Chair?

PRESIDENT ELECT HORNER: The tail end of a convention of this kind is no place for a speech. However, I do want to express my very real appreciation of the honor which I have received and of the responsibility which goes with it. I hope I will be able to follow to some extent the very good work which President Rankin has done.

Before the meeting is adjourned I do want to say something about the committee work for the next year. During the past two years I know the Presidents have had some difficulty in finding members of the Society with the time and energy available in filling out the memberships of all the committees. Under the proposal which the Executive Committee has recommended and which is going out to letter ballot, there will undoubtedly be a considerable reduction in the number of committee memberships. It may result, therefore, in our being able to choose from an excess of real talent. For that reason, it may be possible to relieve some of the men who have been attempting to work on these committees without really having the time available and also to relieve some of our members who have done more than their fair share. I want to ask that all of those who are interested in the work of a particular committee and who have the time available to put into the work of that particular committee write to me personally and let me know the facts.

If there is no further business, the meetings of this convention will stand adjourned for the year.

The Convention adjourned at eleven-twenty o'clock.

ATTENDANCE AT CLEVELAND CONVENTION

Ac-Active; Af-Affiliated; As-Associate member; G-Guest

Abernethy, Alex T., G., New York City.
Adams, H. E., G., Amherst, O.
Ahrens, H. F., Jr., As., Ampere, N. J.
Alden, J. W., G., Newark, N. J.
Anderson, Earl A., Af., E. Cleveland, O.
Andress, Geo. W., Ac., Newark, N. J.
Arnes, G. K., G., Tallahassee, Fla.
Askwith, F. C., Ac., Ottawa, Ont.
Atkins, Guy F., G., Chicago, Ill.

Babcock, C. E. P., Ac., Buffalo, N. Y.
Bailey, John M., G., Pittsburg, Pa.
Baker, G. F., G., Dayton, O.
Baker, Mrs. G. F., G., Dayton, O.
Baker, M. N., G., New York, N. Y.
Banville, F. E., G., Cleveland, O.
Barbour, Frank A., Ac., Boston, Mass.
Barnes, H. E., Ac., Shreveport, La.
Barnes, Mrs. H. E., G., Shreveport, La.
Barrett, R. R., As., New York City.
Barrick, L. M., G., Canton, O.
Bartley, John C., Ac., New Orleans, La.
Bascom, H. F., Ac., Allentown, Pa.
Bascom, Mrs. H. F., G., Allentown, Pa.
Bastis, Albert, Ac., Minneapolis, Minn.
Bauman, F. A., G., Cleveland, O.
Beck, E. A., G., Lynchburg, Va.
Beck, Mrs. F. A., G., Lynchburg, Va.
Beller, B. L., G., Cleveland, O.
Bennett, Mrs. R., G., E. Cleveland, O.
Besselievre, E. B., As., New York City.
Biehl, Richard, Ac., Westerville, O.
Bingham, C. A., G., Lima, O.
Blair, Will P., As., Cleveland, O.
Blake, Montford, G., Cleveland, O.
Blanchard, Arthur H., Ac., Ann Arbor, Mich.
Bookwalter, Parker, G., Dayton, O.
Braumberns, E. H., G., Warren, O.
Briggs, B. E., Ac., Erie, Pa.
Brockway, P. L., Ac., Wichita, Kans.
Brown, C. A., G., Indianapolis, Ind.
Brown, Chas. C., Ac., St. Petersburg, Fla.
Brown, Mrs. C. C., G., St. Petersburg, Fla.
Brown, N. A., Ac., Rochester, N. Y.
Brown, Mrs. N. A., G., Rochester, N. Y.
Buehler, Walter, As., New York, N. Y.
Bugg, D. B., G., Cleveland, O.
Burger, Alfred A., G., Cleveland, O.
Burnside, Lewis E., Ac., Sharon, Pa.
Burnside, Mrs. L. E., G., Sharon, Pa.
Buttenheim, Edgar J., As., New York, N. Y.
Butterfield, E. E., Ac., Long Island City, N. Y.
Buxman, W., G., New York City.

Caldwell, W. L., Ac., Louisville, Ky.
Campbell, F. C., As., Chicago, Ill.
Cash, J. G., G., Cleveland, O.
Cathers, T. S., G., Marion, O.
Cellarius, Frederick J., Ac., Dayton, O.
Champe, George, Ac., Toledo, O.
Child, J. T., G., Rochester, N. Y.
Christ, E. H., Ac., Grand Rapids, Mich.
Clark, E. S., Ac., Kalamazoo, Mich.
Clark, John, G., Kalamazoo, Mich.
Cleveland, H. Burdett, As., New York City.
Clifford, T. J., G., Cleveland, O.
Coats, W. G., As., Chicago, Ill.
Collins, T. E., Ac., Elizabeth, N. J.
Compton, R. Keith, Ac., Baltimore, Md.
Conant, E. R., Ac., Manchester, N. H.
Corson, S. C., Ac., Norristown, Pa.
Covert, C. C., As., Albany, N. Y.
Cowden, M. B., Ac., Harrisburg, Pa.

Crane, Z. G., Ac., West Caldwell, N. J.
Craver, H. H., Ac., Pittsburg, Pa.
Crotty, O. M. G., Cleveland, O.
Crowell, W. E., As., Columbus, O.
Crutcher, T. B., G., Lowell, Ky.
Crutcher, Mrs. T. B., G., Lowell, Ky.
Culverhouse, H. G., Ac., Montgomery, Ala.
Curschmann, S. C., G., Cleveland, O.
Curtis, C. C., G., Canton, O.

Dalton, E. L., Ac., Dallas, Tex.
Daneker, J. G., G., Baltimore, Md.
Danley, P. Y., G., St. Louis, Mo.
Davidson, E. Y., Jr., G., Pittsburg, Pa.
Day, J. J., G., Cleveland, O.
Day, William, Jr., G., Cleveland, O.
Deckman, C. G., G., Cleveland, O.
De Frees, F. B., Ac., Toledo, O.
Dibert, H. M., G., Troy, N. Y.
Dixon, G. G., Ac., Cleveland, O.
Doran, G. W., As., Cincinnati, O.
Doremus, Goline, Ac., Newark, N. J.
Dow, A. W., Ac., New York City.
Drach, Louis, G., Chicago, Ill.
Drach, Mrs. Louis, G., Chicago, Ill.
Dranev, J. R., As., New York, N. Y.
Duff, E. E., Jr., As., Cleveland, O.
Dunham, W. R., Jr., Ac., New Haven, Conn.
Dunn, Frank B., As., Conneaut, O.
Dunn, Mrs. F. B., G., Conneaut, O.
Dunn, Miss Pauline, G., Conneaut, O.
Durham, H. W., Ac., Sandwich, Mass.
Durst, Ross C., G., Akron, O.
Dutton, E. R., Ac., Minneapolis, Minn.
Duty, S. M., As., Cleveland, O.

Eckstein, J. F., G., Cleveland, O.
Eddy, Harrison P., Ac., Boston, Mass.
Edwards, F. D., G., Cleveland, O.
Eichelberger, F. O., Ac., Dayton, O.
Ellis, A. R., As., Pittsburg, Pa.
Elsberg, N. W., Ac., Minneapolis, Minn.
Ericson, L. T., G., Toledo, O.
Evans, R. E. G., G., Louisville, Ky.
Eversole, F. J., G., Canton, O.

Fairtrace, G. D., Ac., Dallas, Tex.
Farrell, F. D., Ac., Buffalo, N. Y.
Ferebee, J. L., Ac., Milwaukee, Wis.
Fern, G. A. E., G., Cincinnati, O.
Ferver, A. L., Ac., Long Beach, Cal.
Filbert, C. B., G., New Orleans, La.
Fisher, E. A., Ac., Lakewood, O.
Fisher, E. A., Ac., Rochester, N. Y.
Fisk, G. F., Ac., Buffalo, N. Y.
Folwell, A. P., Ac., New York City.
Ford, P. T., G., Columbus, O.
Fowler, W. B., Ac., Memphis, Tenn.
Fox, R. L., Ac., Bethlehem, Pa.
Francisco, E., Ac., Newark, N. J.
Freeman, T., G., Cleveland, O.
Fruen, A. B., Ac., Minneapolis, Minn.
Fuchs, P. A., G., Milwaukee, Wis.
Fuller, G. W., Ac., New York City.

Gage, R. B., Ac., Trenton, N. J.
Gallagher, J. F., G., Chicago, Ill.
Galvin, W. E., G., Toledo, O.
Garnett, M. W., G., E. Cleveland, O.
Garvin, E. C., Ac., St. Petersburg, Fla.
Gascoigne, G. B., Ac., Cleveland, O.
Gauss, H. F., G., Akron, O.
George, H. H., Ac., Newark, N. J.
Giberson, T., G., Cleveland, O.
Giesey, J. K., Ac., New York City.
Giff, M. A., G., Chicago, Ill.
Gillum, H. J., As., Chicago, Ill.
Gilmour, W. A., G., Akron, O.
Glass, M. E., G., Cleveland, O.
Godwin, W. S., G., Baltimore, Md.
Goodwin, F. J., G., Cleveland, O.
Graf, Walter W., Ac., Lancaster, O.
Graham, C. S., G., Harrisburg, Pa.
Gray, E. R., Ac., Hamilton, Ont., Canada.
Greeley, S. A., Ac., Chicago, Ill.
Greenough, M. B., As., Chattanooga, Tenn.
Grier, R. H., Ac., Wilmington, Del.
Griffiths, P. L., As., Chicago, Ill.
Grimes, J. F., G., Lexington, Ky.

Haas, O. T., Af., Cleveland, O.
Hackney, J. W., Ac., Atlantic City, N. J.
Haff, R. W., As., New York City.
Hamley, S. J., Ac., Cleveland, O.
Hammatt, C. S., G., Jacksonville, Fla.
Harrigan, D. D., Ac., San Antonio, Tex.
Hart, R. W. B., G., Lynchburg, Va.

Hatton, T. C., Ac., Milwaukee, Wis.
Haug, M. E., G., Portsmouth, Va.
Havens, W. L., G., Cleveland, O.
Hawkins, A. J., Ac., Birmingham, Ala.
Hayden, F. M., G., Cleveland, O.
Haynes, R. O., G., Ashland, O.
Heckman, L. F., G., Buffalo, N. Y.
Heffelfinger, J. M., G., Cleveland, O.
Heglaw, V. E., G., Cleveland, O.
Helm, J. S., As., New Orleans, La.
Hempelmann, W. I., As., Chicago, Ill.
Herron, J. H., G., Cleveland, O.
Hill, D. H., G., Cleveland, O.
Hill, L. E., G., Lakewood, O.
Hittell, J. B., Ac., Chicago, Ill.
Hittell, Mrs. J. B., G., Chicago, Ill.
Holmes, G. D., Ac., Syracuse, N. Y.
Horner, W. W., Ac., St. Louis, Mo.
Horner, Mrs. W. W., G., St. Louis, Mo.
Houghton, W. S., G., Boston, Mass.
Howald, Harold, G., Massillon, O.
Howard, H. W., G., Pontiac, Mich.
Howell, C. L., Ac., Buffalo, N. Y.
Howell, W. A., Ac., Newark, N. J.
Hubbard, P., Ac., New York City.
Hull, R. R., Ac., Buffalo, N. Y.
Hume, S. W., G., New York, N. Y.
Hurst, F. J., G., Philadelphia, Pa.
Hutchins, R. T., G., Wheeling, W. Va.
Hutton, H. S., G., Pittsburg, Pa.
Hvass, C. T., As., New York City.

Irish, A. F., G., Cleveland, O.

Jackson, W. T., G., Toledo, O.
Jenkins, H. S., Af., Cleveland, O.
Johnson, W. H., G., Columbus, O.
Jones, F. W., G., Cleveland, O.
Jones, H. P., Ac., Toledo, O.
Jones, M. T., G., Cleveland, O.
Jones, V. W., G., Cleveland, O.
Joublanc, J. C., G., Canton, O.

Kane, I. P., G., Chicago, Ill.
Keefer, C. E., Ac., Baltimore, Md.
Kemmler, E. A., Ac., Akron, O.
Kemmler, Mrs. E. A., G., Akron, O.
Kendall, T. R., As., New York, N. Y.
Kent, L. C., G., Cleveland, O.
Kershaw, W. H., As., New York City.
King, C. S., G., Wilkesbarre, Pa.
Kingsley, E. A., Ac., Dallas, Tex.
Kinner, Miss G., Conneaut, O.
Kinsey, E. R., Ac., St. Louis, Mo.
Kleeberg, F., Ac., New York City.
Klorer, J., Ac., New Orleans, La.
Knight, S. D., G., Cleveland, O.
Knisely, S. A., G., Cleveland, O.
Knowles, M., Ac., Pittsburg, Pa.
Kolp, C. A., G., Canton, O.
Krieger, A. A., Ac., Louisville, Ky.
Krug, F. S., Jr., G., Columbus, O.

Landen, J. C., G., New York City.
LaRue, L., G., Akron, O.
Lauderbaugh, H. B., G., Pittsburg, Pa.
Laurgaard, O., Ac., Portland, Ore.
Leach, W. L., G., Cleveland, O.
Legaré, T. K., Ac., Columbia, S. C.
Lenth, G. C. D., As., Chicago, Ill.
Levy, H. W., G., New York, N. Y.
Lewis, N. P., Ac., Brooklyn, N. Y.
Lewis, R. L., G., Columbus, O.
Lillie, F. M., G., Youngstown, O.
Lockwood, E. D., G., Detroit, Mich.
Logan, H., G., Lakewood, O.
Logan, H. A., G., Cincinnati, O.
Logan, Mrs. H. A., G., Cincinnati, O.

MacCarthy, V., G., Philadelphia, Pa.
MacDowell, R. F., G., Cleveland, O.
MacLeod, M. R., G., Cleveland, O.
MacTammany, J. B., G., Cincinnati, O.
Maetzel, Henry, Ac., Columbus, O.
Maetzel, Mrs. H., G., Columbus, O.
Maier, H. L., Ac., Wilmington, Del.
March, H. J., G., Buffalo, N. Y.

Martin, G. E., As., Chicago, Ill.
Masury, A. F., Af., New York City.
McClintock, J. R., Ac., Kansas City, Mo.
McConville, T., G., Cleveland, O.
McCormick, P. S., As., Baltimore, Md.
McGurk, J. F., G., Chicago, Ill.
McOmber, L. W., G., Peoria, Ill.
McOmber, Mrs. L. W., G., Peoria, Ill.
McVea, J. C., Ac., Houston, Tex.
Mebus, Charles F., Ac., Philadelphia, Pa.
Mebus, Miss Cecilia, G., Philadelphia, Pa.
Merrick, T. B., G., Richmond, Va.
Merriman, M. W., G., Cleveland, O.
Metz, L. V., Ac., Erie, Pa.
Miller, V. C., G., Lima, O.
Miller, Mrs. V. C., G., Lima, O.
Moerk, F. N., G., Philadelphia, Pa.
Monroe, L. W., Ac., Meadville, Pa.
Mooney, T. G., G., New York City.
Morris, J. V., G., Canton, O.
Morris, J. W., G., Cleveland, O.
Moynihan, A. J., G., Chicago, Ill.
Mullen, C. A., Ac., Montreal, Que., Canada.
Munday, A. J., G., Chicago, Ill.
Murdock, S. H., G., Cleveland, O.
Murphy, C. E., As., New York City.
Murphy, E. F., G., Boston, Mass.

Near, J. R., G., St. Catherine, Ont., Canada.
Near, Mrs. J. R., G., St. Catherine, Ont., Canada.
Near, W. P., Ac., St. Catherine, Ont., Canada.
Near, Mrs. W. P., G., St. Catherine, Ont., Canada.
Nevitt, J. H., Ac., Toronto, Ont.
Newcomb, W. T., Af., Easton, Pa.
Newman, J. P., G., Cleveland, O.
Norton, G. H., Ac., Buffalo, N. Y.
Norton, Mrs. G. H., G., Buffalo, N. Y.

Olson, Victor, G., Youngstown, O.
Osborn, C. M., Ac., Kenosha, Wis.
Osborn, K. H., G., Cleveland, O.
Osgood, H. N., G., Lima, O.
Owen, L. T., G., Toledo, O.

Parr, T. C., G., Cleveland, O.
Parr, W. J., G., Cleveland, O.
Parsons, E. E., G., Springfield, Ohio.
Patterson, F. W., G., Youngstown, O.
Patterson, R. G., G., Columbus, O.
Patzig, M. L., Ac., Des Moines, Ia.
Pearse, L., Ac., Chicago, Ill.
Peirce, V. M., G., Washington, D. C.
Perkins, W. C., As., Philadelphia, Pa.
Phillips, R. L., Ac., Meadville, Pa.
Phillips, Mrs. R. L., G., Meadville, Pa.
Pierson, F. W., Ac., Wilmington, Del.
Place, A. H., Af., Detroit, Mich.
Platzer, W. W., G., Chicago, Ill.
Pollock, C. D., Ac., New York City.
Poole, C. A., Ac., Rochester, N. Y.
Porterfield, W. A., G., Canton, O.
Powell, J. M., Ac, Elyria, O.

Quinlan, E. A., G., East Orange, N. J.

Rankin, E. S., Ac., Newark, N. J.
Rankin, E. S., G., Cleveland, O.
Reid, J. W., Ac., Detroit, Mich.
Reimer, F. A., Ac., Newark, N. J.
Rein, L. E., G., Chicago, Ill.
Reinwald, Harry, G., Cleveland, O.
Reinwald, Mrs. Harry, G., Cleveland, O.
Requardt, G. J., Ac., Baltimore, Md.
Rhodes, E. O., As., Chicago, Ill.
Rice, C. E., G., Wooster, O.
Rice, J. L., G., Philadelphia, Pa.
Rice, J. M., Ac., Pittsburg, Pa.
Rice, Mrs. J. M., G., Pittsburg, Pa.
Ripley, E. T., G., Cleveland, O.
Robinson, E. M., As., Memphis, Tenn.
Rochford, H. T., Ac., Buffalo, N. Y.
Rochford, Mrs. H. T., G., Buffalo, N. Y.
Rogers, H. W., G., Cleveland, O.

Rolph, T. W., As., Newark, O.
Rolph, Mrs. T. W. and son, G., Newark, O.
Rose, A. O., Ac., Cleveland, O.
Rose, W. E., G., Cleveland, O.
Rowland, H. A., Ac., McPherson, Kans.
Russell, B. S., Jr., G., Cleveland, O.

Sarver, W. E., Ac., Canton, O.
Sauer, Mrs. R. D., G., Cincinnati, O.
Saville, A. J., Ac., Richmond, Va.
Saville, R. L., G., Richmond, Va.
Schaetzle, T. C., Ac., Baltimore, Md.
Schultz, F. E., G., Wooster, O.
Schutt, H. G., Ac., Bluefield, W. Va.
Schwartz, W. F., Ac., Buffalo, N. Y.
Schwemler, F. J., Ac., Cleveland, O.
Senn, G. J., G., Cleveland, O.
Sessions, R. L., Ac., Dayton, O.
Sheaf, F. W., Ac., Rutherford, N. J.
Sheddan, W. E., Ac., Jacksonville, Fla.
Sheddan, Mrs. W. E., G., Jacksonville, Fla.
Shelley, H. T., As., Philadelphia, Pa.
Shelly, G. W., G., Thornville, O.
Shelton, W. H., Ac., Dunkirk, N. Y.
Simpson, R. H., G., Columbus, O.
Smith, B. M., As., Chicago, Ill.
Smith, F. P., Ac., New York City.
Smith, Gordon, G., New York City.
Smith, J. J., G., New York City.
Smith, M. C., G., Cleveland, O.
Sprague, N. S., Ac., Pittsburg, Pa.
Stanhope, C. R., G., Ashtabula, O.
Stewart, J., G., Cleveland, O.
Stickel, W. A., Ac., Newark, N. J.
Stocking, E. J., G., Chicago, Ill.
Stone, W. H., Af., Baltimore, Md.
Suker, A. E., G., Cincinnati, O.
Swain, A. L., G., Newark, N. J.
Symons, J. H., G., Kansas City, Mo.

Tark, M. B., As., Philadelphia, Pa.
Taylor, G. E., G., Charleston, W. Va.
Taylor, P. R., Ac., Grand Haven, Mich.
Thoman, W. F., G., Shreveport, La.
Thomas, F. A., Ac., Cleveland, O.
Tillson, G. W., Ac., LaGrange, Ill.
Toensfeldt, R., Ac., St. Louis, Mo.
Tolles, Frank C., Ac., Akron, Ohio.
Tope, John, G., Hamilton, Ont., Canada.
Travilla, J. C., As., St. Louis, Mo.
Travilla, Mrs. J. C., G., St. Louis, Mo.

Ulmer, J. C., G., Cleveland, O.
Ulrich, E. B., Ac., Reading, Pa.
Underwood, C. H., Ac., Indianapolis, Ind.

Varney, H. A., Ac., Brookline, Mass.

Wallace, Irene, G., Pittsburg, Pa.
Walters, R. E., Ac., Tarentum, Pa.
Walther, J. T., G., Akron, O.
Walton, G., G., Cleveland, O.
Walton, G. W., G., Columbus, O.
Warren, G. C., As., Boston, Mass.
Wasser, T. J., Ac., Trenton, N. J.
Watson, R. M., Ac., Rutherford, N. J.
Watt, W. L., G., Cleveland, O.
Watts, R. C., G., Cleveland, O.
Wersant, P. D., G., Pittsburg, Pa.
Wheeler, L. E., G., South Bend, Ind.
Whitten, Robert, Ac., Cleveland, O.
Widger, F. V., As., Chicago, Ill.
Williams, F. R., As., Cleveland, O.
Williamson, J. G., G., Chicago, Ill.
Wittenberg, L., G., New York, N. Y.
Worcester, W. E., G., Philadelphia, Pa.
Wyatt, DeWitt H., G., Columbus, O.
Wynne-Roberts, R. O., Ac., Toronto, Ont., Can.
Wynne-Roberts, Mrs. R. O., G., Toronto, Ont., Can.

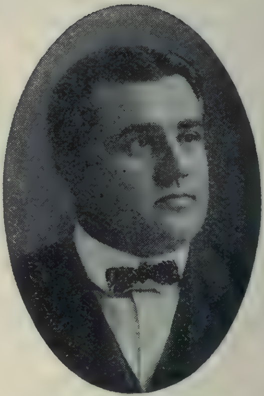
Yount, W. M., G., Warren, O.

LIST OF EXHIBITORS

American City, The	New York City
American Tar Products Co	Chicago, Ill.
Asphalt Association, The	New York City
Barrett Co., The	New York City
Bitoslag Paving Co	New York City
Cincinnati Quarries Co	Cincinnati, Ohio
Cleveland Stone Co	Cleveland, Ohio
Cleveland Trinidad Paving Co	Cleveland, Ohio
Common Brick Mfrs. Association	Cleveland, Ohio
Cummer & Son Co., The F. D	Cleveland, Ohio
Dunn Wire-Cut Lug Brick Co	Conneaut, Ohio
Eastern Clay Products Assn	Philadelphia, Pa.
Elliott Co., B. K	Cleveland, Ohio
Engineering & Contracting	Chicago, Ill.
Engineering News-Record	New York City
Essco Manufacturing Co	Peoria, Ill.
General Motors Truck Co	Pontiac, Mich.
Godwin Co. Inc., W. S	Baltimore, Md.
Gurley, W. & L. E	Troy, N. Y.
Highway Engineer & Contractor	Chicago, Ill.
Holophane Glass Co	New York City
Hvass Co., Charles	New York City
International Steel Tie Co	Cleveland, Ohio
Kentucky Rock Asphalt Co	Louisville, Ky.
Kinney Mfg. Co	Chicago, Ill.
Link Belt Co	Philadelphia, Pa.
Lock Joint Pipe Co	E. Orange, N. J.
Macbeth-Evans Glass Co	Pittsburg, Pa.
Madison Foundry Co	Cleveland, Ohio
Manufacturers Record	Baltimore, Md.
Mound Traffic Equipment Co	Columbus, Ohio
National Lamp Works of General Electric Company	Cleveland, Ohio
National Paving Brick Mfrs. Assn	Cleveland, Ohio
Ohio Paving Brick Mfrs. Assn	Columbus, Ohio
Ohio Quarries Co	Cleveland, Ohio
Parr Paint & Color Co	Cleveland, Ohio
Pittsburg Testing Laboratory	Pittsburg, Pa.
Public Works	New York City
Texas Co., The	New York City
Turbine Sewer Machine Co	Milwaukee, Wis.
Ulmer Co., J. C	Cleveland, Ohio
United States Asphalt Ref. Co	New York
Warren Brothers Co	Boston, Mass.
Watson Engineering Co	Cleveland, Ohio
White Co., The	Cleveland, Ohio
Wood & Co., R. D	Philadelphia, Pa.

W. W. Horner
President

Ellis R. Dutton
First Vice-President



Herman H. Smith
Second Vice-President

E. L. Dalton
Third Vice-President

Charles C. Brown
Secretary

Robert Hoffman
Treasurer

OFFICERS OF THE SOCIETY

OFFICERS OF THE SOCIETY FOR THE YEAR 1922–1923

President	W. W. HORNER	St. Louis, Mo.
First Vice-President	ELLIS R. DUTTON	Minneapolis, Minn.
Second Vice-President	HERMAN H. SMITH	New York City
Third Vice-President	E. L. DALTON	Dallas, Texas
Secretary	CHARLES C. BROWN.	St. Petersburg, Fla.
Treasurer	ROBERT HOFFMAN	Cleveland, Ohio

Finance Committee

C. A. POOLE, *Chairman*	Rochester, N. Y.
H. E. BARNES	Shreveport, La.
HARRY L. MAIER	Wilmington, Del.

Executive Committee

The officers of the Society, together with the Past Presidents who have retained their continuous membership, constitute the Executive Committee. The names of the Past Presidents are given below.

CONVENTIONS AND PAST PRESIDENTS OF THE SOCIETY

First	1894	Buffalo	M. J. Murphy (deceased) St. Louis
Second	1895	Cincinnati	M. J. Murphy (deceased) St. Louis
Third	1896	Chicago	Geo. H. Benzenberg, Milwaukee
Fourth	1897	Nashville	August Herrmann, Cincinnati
Fifth	1898	Washington	H. Van Duyne (deceased) Newark
Sixth	1899	Toronto	Nelson P. Lewis, New York
Seventh	1900	Milwaukee	A. D. Thompson, Peoria
Eighth	1901	Niagara Falls	Robert E. McMath (deceased) St. Louis
Ninth	1902	Rochester	E. A. Fisher, Rochester
Tenth	1903	Indianapolis	C. H. Rust, Toronto
Eleventh	1904	St. Louis	G. M. Ballard (deceased) Newark
Twelfth	1905	Montreal	A. Prescott Folwell, New York
Thirteenth	1906	Birmingham	Charles C. Brown, St. Petersburg
Fourteenth	1907	Detroit	Morris R. Sherrerd, Newark
Fifteenth	1908	Atlantic City	George W. Tillson, LaGrange
Sixteenth	1909	Little Rock	James Owen (deceased) Orlando
Seventeenth	1910	Erie	Julian Kendrick, Birmingham
Eighteenth	1911	Grand Rapids	Fred Giddings (deceased) Charlotte
Nineteenth	1912	Dallas	E. A. Kingsley, Dallas
Twentieth	1913	Wilmington	B. E. Briggs, Erie
Twenty-first	1914	Boston	E. H. Christ, Grand Rapids
Twenty-second	1915	Dayton	William A. Howell (deceased) Newark
Twenty-third	1916	Newark	A. F. Macallum, Ottawa
None	1917	Convention omitted on account of the war	
Twenty-fourth	1918	Buffalo	N. S. Sprague, Pittsburg
Twenty-fifth	1919	New Orleans	E. R. Conant, Manchester
Twenty-sixth	1920	St. Louis	G. H. Norton, Buffalo
Twenty-seventh	1921	Baltimore	R. Keith Compton, Baltimore
Twenty-eighth	1922	Cleveland	E. S. Rankin, Newark

STANDING COMMITTEES 1922–1923

GENERAL COMMITTEES

1. Street Paving and Street Design

E. R. CONANT, *Chairman*	Manchester, N. H.
H. E. BARNES	Shreveport, La.
S. Q. CANNON	Salt Lake City, Utah
W. H. TAYLOR	Norfolk, Va.
P. L. BROCKWAY	Wichita, Kans.

2. Street Maintenance, Street Cleaning and Snow Removal

G. H. NORTON, *Chairman*	Buffalo, N. Y.
A. P. FOLWELL	New York City
E. C. GARVIN	St. Petersburg, Fla.

3. City Planning

NELSON P. LEWIS, *Chairman*	New York City
E. A. FISHER	Rochester, N. Y.
HARLAND BARTHOLOMEW	St. Louis, Mo.
G. J. REQUARDT	Baltimore, Md.
A. H. BLANCHARD	Ann Arbor, Mich.

4. Public Welfare

JEFFERSON C. GRINNALDS, *Chairman*	Baltimore, Md.
J. M. RICE	Pittsburg, Pa.
H. F. BASCOM	Allentown, Pa.

5. Street Lighting

RALPH TOENSFELDT, *Chairman*	St. Louis, Mo.
E. A. ANDERSON	Cleveland, O.
C. W. KOINER	Pasadena, Calif.
ELLSWORTH FRANCISCO	Newark, N. J.
C. M. OSBORN	Kenosha, Wis.

6. Sewerage, Sanitation and Garbage Disposal

HARRISON P. EDDY, *Chairman*	Boston, Mass.
SAMUEL A. GREELEY	Chicago, Ill.
T. C. HATTON	Milwaukee, Wis.
J. C. McVEA	Houston, Tex.
C. A. POOLE	Rochester, N. Y.
LANGDON PEARSE	Chicago, Ill.

7. Water Works

GEORGE W. FULLER, *Chairman*	New York City
E. E. WALL	St. Louis, Mo.
G. G. EARL	New Orleans, La.

8. Municipal Legislation and Finance

J. E. BARLOW, *Chairman*	New London, Conn.
HARRINGTON PLACE	Detroit, Mich.
J. W. REID	Detroit, Mich.

9. Public Safety

ALCIDE CHAUSSÉ, *Chairman*	Montreal, Can.
DOUGLAS CORNELL	Buffalo, N. Y.
H. G. PERRING	Baltimore, Md.
W. C. E. BECKER	St. Louis, Mo.
P. C. PAINTER	Greensboro, N. C.

10. Convention Papers

CHARLES C. BROWN, *Chairman*	St. Petersburg, Fla.
GEO. W. TILLSON	La Grange, Ill.
W. W. HORNER	St. Louis, Mo.

11. Publicity

CHARLES C. BROWN, *Chairman*	St. Petersburg, Fla.
A. P. FOLWELL	New York City
S. C. HADDEN	Indianapolis, Ind.
R. K. TOMLIN	New York City

12. Membership

F. R. DUTTON, *Chairman*	Minneapolis, Minn.
J. H. MACDONALD	New Haven, Conn.
H. H. SMITH	New York City
H. A. VARNEY	Brookline, Mass.
T. E. COLLINS	Elizabeth, N. J.
EDMUND B. ULRICH	Reading, Pa.
T. K. LEGARÉ	Columbia, S. C.
C. C. BROWN	St. Petersburg, Fla.
E. A. FISHER	Lakewood, Ohio
D. B. DAVIS	Richmond, Ind.
E. A. KINGSLEY	Dallas, Tex.
E. L. DALTON	Dallas, Tex.
W. W. HORNER	St. Louis, Mo.
E. R. CONANT	Manchester, N. H.
S. Q. CANNON	Salt Lake City, Utah.
A. L. FERVER	Long Beach, Calif.
A. F. MACALLUM	Ottawa, Ont., Canada.
GEORGE W. CRAIG	Calgary, Alberta, Can.
J. C. TRAVILLA	St. Louis, Mo.
H. H. GEORGE	Newark, N. J.
W. B. FOWLER	Memphis, Tenn.
R. KEITH COMPTON	Baltimore, Md.
H. E. BARNES	Shreveport, La.

H. G. SCHUTT	Bluefield, W. Va.
JOHN B. HITTELL	Chicago, Ill.
R. E. BRAGSTAD	Sioux Falls, S. D.
E. E. PARKER	Madison, Wis.

13. CONVENTION ARRANGEMENTS

W. B. FOWLER, *Chairman*	Memphis, Tenn.

SPECIFICATIONS COMMITTEES

1. BITUMINOUS PAVEMENTS

E. A. KINGSLEY, *Chairman*	Dallas, Tex.
D. P. SMITH	New York City
A. B. DAVIS	Richmond, Ind.
T. A. KRIEGER	Louisville, Ky.
F. E. COLLINS	Elizabeth, N. J.

2. BRICK PAVEMENTS

GRO. F. FISK, *Chairman*	Buffalo, N. Y.
E. A. FISHER	Lakewood, Ohio
ALDEN CHASE	St. Louis, Mo.

3. CEMENT CONCRETE PAVEMENTS

D. Q. McCOMB, *Chairman*	Nashville, Tenn.
A. B. FLETCHER	Sacramento, Calif.
E. E. BUTTERFIELD	Long Island City, N. Y.
E. L. DALTON	Dallas, Tex.
G. A. CRAYTON	Springfield, Ill.

4. STONE BLOCK PAVEMENTS

R. A. MacGREGOR, *Chairman*	New York City
WM. A. HANSELL	Atlanta, Ga.
C. D. POLLOCK	New York City

5. WOOD BLOCK PAVEMENTS

JOHN KLORER, *Chairman*	New Orleans, La.
GEORGE CHAMPE	Toledo, Ohio
D. D. HARRIGAN	San Antonio, Tex.

6. SIDEWALKS AND CURBS

W. H. WISE, *Chairman*	Augusta, Ga.
J. W. HACKNEY	Atlantic City, N. J.
H. A. ROWLAND	McPherson, Kans.

7. SEWERS

E. S. RANKIN, *Chairman*	Newark, N. J.
CARL L. HOWELL	Buffalo, N. Y.
GUY BROWN	St. Louis, Mo.

8. Subgrades and Foundations

H. E. BREED, *Chairman*	New York City
R. L. PHILLIPS	Meadville, Pa.
M. L. PATZIG	Des Moines, Iowa

9. Street Railway Pavements and Track Construction

C. E. DeLEUW, *Chairman*	Chicago, Ill.
HENRY MAETZEL	Columbus, Ohio
C. L. HAWKINS	St. Louis, Mo.
H. H. GEORGE	Newark, N. J.

REPRESENTATIVES IN OTHER ORGANIZATIONS

American Society for Testing Materials

Committee D-4 on Road Materials

HERMAN H. SMITH, *Delegate*	Brooklyn, N. Y.
ARTHUR H. BLANCHARD, *Alternate*	Ann Arbor, Mich.

Committee C-4 on Clay and Cement Sewer Pipe

E. S. RANKIN, *Delegate*	Newark, N. J.
CARL L. HOWELL, *Alternate*	Buffalo, N. Y.

Committee C-9 on Concrete and Concrete Aggregates

H. ELTINGE BREED, *Delegate*	New York City

Committee C-3 on Brick

GEO. H. FISK, *Delegate*	Buffalo, N. Y.

Committee C-7 on Lime

CHARLES CARROLL BROWN, *Delegate*	St. Petersburg, Fla.

National Research Council

Division of Engineering

NELSON P. LEWIS, *Delegate*	New York City
R. KEITH COMPTON, *Alternate*	Baltimore, Md.

National Safety Council

E. R. DUTTON, *Delegate*	Minneapolis, Minn.
C. M. REPPERT, *Alternate*	Pittsburg, Pa.

U. S. Department of Commerce, Division of Simplified Practice

Paving Brick Committee

G. F. FISK, *Delegate*	Buffalo, N.Y.
E. A. FISHER, *Alternate*	Lakewood, O.

Committee on Standards for Drinking Water

MORRIS R. SHERRERD, *Delegate*	Newark, N. J.
J. W. ARMSTRONG, *Alternate*	Baltimore, Md.

Committee on Grades of Asphalt

R. KEITH COMPTON, *Delegate*	Baltimore, Md.

American Engineering Standards Committee

Committee on Standard Tests for Penetration for Bituminous Materials Joint Sponsor

A. W. DOW, *Delegate*....................................New York City
PREVOST HUBBARD, *Alternate*......................New York City

Committee on Concrete Aggregates

Standard Test for Unit Weight of Aggregate for Concrete
(A. S. T. M., C 29-21)

Standard Test for Voids in Fine Aggregate for Concrete
(A. S. T. M., C 30-22)

Standard Test for Organic Impurities in Sands for Concrete
(A. S. T. M., C 40-22)

H. E. BREED, *Delegate*..................................New York City

Committee on Specifications for Materials for Use in the Manufacture of Special Track Work and Design of 7-inch Plain Girder T-rail

CHARLES E. DeLEUW, *Delegate*.............................Chicago, Ill.
C. L. HAWKINS, *Alternate*...................................St. Louis, Mo.

Committee on Specifications for Wood Poles and for Tubular Poles

GERALD J. WAGNER, *Delegate*..................Grand Rapids, Mich.

Committee on Specifications for 600-volt Direct-Current Overhead-Trolley Construction

HENRY MAETZEL, *Delegate*.............................Columbus, O.

Committee on Specifications for National Standard of Colors for Traffic Signals

FREDERIC A. REIMER, *Delegate*......................Newark, N. J.

Committee on Cast Iron Gas Pipe and Special Castings

RALPH TOENSFELDT, *Delegate*.......................St. Louis, Mo.

American Construction Council

R. KEITH COMPTON, *Delegate*.......................Baltimore, Md.
ALEXANDER POTTER, *Delegate*.....................New York City
JAMES W. COSTELLO, *Delegate*.......................Newark, N. J.

International Engineering Congress, Rio de Janeiro, Brazil

V. da Silva Freire, *Delegate*..........................Sao Paulo, Brazil

MEMBERSHIP LIST

ACTIVE MEMBERS

Ackerman, J. Walter, City Manager, Watertown, N. Y.	1905
Adler, Julius, Deputy Chief, Bureau of Highways, Philadelphia, Pa.	1921
Aldrich, Bruce, Manager Provincial Contracting Company, Ltd., Toronto, Ont., Canada	1919
Aldridge, William, Assistant City Engineer, 333 McGee St., Winnipeg, Manitoba, Can	1912
Allen, Henry C., Consulting Engineer, Syracuse, N. Y.	1895
Allen, Kenneth, Sanitary Engineer, Board of Estimate and Apportionment, 1235 Municipal Building, New York City	1920
Allin, Thomas D., Allin Brothers, Civil Engineers, 303 Kendall Building, Pasadena, Calif.	1905
Anderson, M. J., Vice Chairman, Board of Water Commissioners, Memphis Artesian Water Department, 105 N. 2d St., Memphis, Tenn.	1923
Andress, George W., Senior Engineer, Division of Works, 445 Summer Ave., Newark, N. J.	1921
Anthony, Harvey Mitchell, Consulting Electrical Engineer, Member Indiana State Board for Registering and Examining of Professional Engineers and Land Surveyors, Anthony Building, Muncie, Ind.	1921
Armstrong, J. W., Filtration Engineer, Water Department, Lake Montebello, Hillen Road, Baltimore, Md.	1921
Ash, Louis R., Harrington, Howard and Ash, Consulting Engineers, Kansas City, Mo.	1911
Askwith, F. C., Deputy City Engineer, 222 Powell Ave., Ottawa, Ont., Canada	1916
Atwood, Joshua, Engineer in Charge Paving Service, 501 City Hall Annex, Boston, Mass.	1914
Babcock, C. E. P., First Assistant Engineer, 20 Municipal Building, Buffalo, N. Y.	1914
Baechlin, Ernest, Town Engineer, National Bank Building, Bloomfield, N. J.	1916
Baillarge, W. D., City Engineer, Quebec, Que., Canada	1912
Bair, Maurice Z., Chief Engineer, State Board of Health, Little Rock, Ark.	1920
Baldry, William Earnest, City Engineer, 1106 W. 13th St., Topeka, Kans.	1918
Barbour, Frank A., Consulting Engineer, Barbour and Dixon, Tremont Building, Boston, Mass., and Finance Building, Cleveland, Ohio	1914
Barlow, James E., City Manager, City Hall, New London, Conn.	1910
Barnes, H. E., City Engineer, City Hall, Shreveport, La.	1920
Bartholomew, Harland, Engineer City Plan Commission, 231 Municipal Courts Building, St. Louis, Mo.	1914
Bartley, John C., Secretary to Superintendent Sewerage and Water Board, 402 Sewerage and Water Board Building, New Orleans, La.	1920
Bartow, Edward, Head of Department of Chemistry, State University of Iowa, Iowa City, Iowa	1920
Bascom, H. F., City Engineer, City Hall, Allentown, Pa.	1920
Bastis, Albert G., Chairman Committee on Paving, 2629 S. 6th St., Minneapolis, Minn.	1917
Batson, S. R., City Engineer of Bessemer, 411 N. 30th St., Birmingham, Ala.	1920

Battershill, J. D., Municipal Engineer, Box 15, East Kildonan, Manitoba, Can. 1920
Baylis, J. R., Principal Sanitary Chemist, City Water Department, Montebello Filters, Hillen Road, Baltimore, Md. 1911
Becker, W. C., Chief Engineer Dept. Public Safety, St. Louis, Mo. 1923
Bennett, Boyd A., City Manager, Charlottesville, Va. 1921
Benzenberg, George H., Consulting Engineer, 1018 Wells Building, Milwaukee, Wis. 1894
Berthe, L. T., City Engineer, President Berthe Engineering Company, Charleston, Mo. 1917
Besson, Major F. S., Assistant to Engineer Commissioner, District of Columbia, District Building, Washington, D. C. 1922
Biehl, Richard, City Manager, Westerville, Ohio 1922
Black, Wilbert, Commissioner of Public Property, City Hall, New Orleans, La. 1922
Blackwell, W. T., General Lighting Representative, Public Service Electric Company, 80 Park Place, Newark, N. J. 1923
Blanchard, Arthur H., Professor of Highway Engineering and Highway Transport, Engineering Building, University of Michigan, Ann Arbor, Mich. 1909
Bohannon, John N., County and Project Engineer, Sandersville, Ga. 1919
Bowles, J. D., Chief Engineer, Federal Light and Traction Co., 52 William St., New York City 1923
Boyd, Charles O., Res. Engr., State Hy. Com., P. O. Box 524, Raleigh, N. C. 1920
Bragstad, R. E., Assistant City Engineer, Sioux Falls, S. D. 1922
Brannan, Thomas H., Engineer the Franklin Asphalt Paving Company, 209 S. High St., Columbus, Ohio 1913
Breed, H. Eltinge, Consulting Engineer, Room 600, 507 Fifth Ave., New York City, N. Y. 1921
Brennan, W. C., W. C. Brennan Contracting Company, Hamilton, Ont., Can. 1909
Brewer, W. H., City Engineer, City Hall, Terre Haute, Ind. 1922
Briggs, B. E., Consulting Engineer, 207 Marine Bank Building, Erie, Pa. 1902
Brockway, P. L., City Engineer, Wichita, Kans. 1918
Brown, Charles Carroll, Consulting Engineer, P. O. Box 234, St. Petersburg, Fla. 1895
Brown, Guy, Principal Assistant Engineer Sewer Design, St. Louis, Mo. 1920
Brown, N. Adelbert, Engineer Sewage Disposal, 152 Post Ave., Rochester, N. Y. 1921
Brown, Thurber A., City Engineer, 416 E. Church St., Elmira, N. Y. 1908
Bull, Irving C., Bull and Roberts, 50 West St., New York City, N. Y. 1912
Burnside, Lewis E., City Engineer, City Building, Sharon, Pa. 1922
Buswell, A. M., Chief State Water Survey Division, Urbana, Ill. 1920
Butterfield, Elmore E., in charge of Laboratory, Boro of Queens, 68 Hunters Point Ave., Long Island City, N. Y. 1921

Caldwell, David C., Consulting Municipal Engineer, Louisville, Ky. 1922
Caldwell, Wallace L., Assistant to President, Kentucky Rock Asphalt Company, Marion E. Taylor Building, Louisville, Ky. 1913
Cannon, Sylvester Q., City Engineer, Salt Lake City, Utah 1915
Carpenter, George A., City Engineer, Pawtucket, R. I. 1905
Carroll, James E., Consulting Engineer, Claussen & Carroll, 406 Metropolitan Bank Bldg., St. Paul, Minn. 1921
Carson, H. O., City Engineer, Central Fire Station, W. North Street, Butler, Pa. 1917
Carter, Hugh R., 803 A. O. U. W. Bldg., Little Rock, Ark. 1909

Cellarius, Frederick J., Consulting Engineer, 1001 Commercial Bldg., Dayton, O.........1910

Champe, George, Civil Engineer, 610 Nasby Bldg., Toledo, Ohio.....1920

Chase, Alden, Engineer of Construction, Sewers and Paving Division, St. Louis, Mo.........1920

Chaussé, Alcide, Hon. Secretary Royal Architectural Institute of Canada, P. O. Box 304, Montreal, Que., Can.........1901

Christ, Edward H., Civil and Consulting Engineer, Norris Building, Grand Rapids, Mich.........1908

Christhilf, A. E., Chief Engineer, City Hall, Baltimore, Md.........1912

Clark, Edward S., City Engineer, Kalamazoo, Mich.........1921

Claussen, Oscar, Consulting Engineer, Claussen & Carroll, 406 Metropolitan Bank Bldg., St. Paul, Minn.........1921

Cleveland, H. Burdett, Consulting Sanitary Engineer, 28 Park Row, New York City, N. Y.........1922

Codwise, Edward B., City Engineer, 298 Wall St., Kingston, N. Y...1906

Coile, C. E., Engineer for Greene Co. Pike Commission and City Engineer, Greeneville, Tenn.........1916

Collier, Henry L., Civil Engineer, Atlanta, Ga.........1908

Collins, Clarke P., Manager Clarksburg Engineering Company, Inc., 801–2 Goff Building, Clarksburg, W. Va.........1909

Collins, Thomas E., City Engineer, City Hall, Elizabeth, N. J.......1916

Compton, R. Keith, Chairman and Consulting Engineer, Paving Commission, 214 E. Lexington St., Baltimore, Md.........1915

Conant, Elbridge R., 121 Bay St., Manchester, N. H.........1913

Cooper, C. M., City Engineer, Girard, Kansas.........1913

Cornell, Douglas, Structural Engineer, Bureau of Buildings, 6 Municipal Building, Buffalo, N. Y.........1915

Corning, Dudley T., Valuation Engineer Natural Resources, Treasury Department, 410 The Ontario, Washington, D. C.........1909

Corson, S. Cameron, Boro Engineer, City Hall, Norristown, Pa......1908

Costello, James W., Chief Engineer, Division of Works, City Hall, Newark, N. J.........1919

Cowden, M. B., City Engineer, Harrisburg, Pa.........1916

Craig, George W., City Engineer, City Hall, Calgary, Alberta, Can.....1911

Craver, H. H., Manager Chemical Department, Pittsburg Testing Laboratory, 616 Grant St., Pittsburg, Pa.........1914

Crayton, G. A., Division of Highways, Springfield, Ill.........1912

Crosby, Walter W., Consulting Engineer, 307 E. 30th St., Baltimore, Md.........1909

Culverhouse, Harry G., Assistant State Engineer, Bell Building, Montgomery, Ala.........1919

Curfman, Lawrence E., City Engineer, 406 W. Adams Ave., Pittsburg, Kans.........1910

Currie, C. H., Consulting Engineer, Webster City, Iowa.........1917

Currie, W. A., Alderman, 4th Ward, Minneapolis, Minn.........1921

Curtis, Thomas H., Civil Engineer, Fairmont, Minn.........1921

Cutcheon, L. D., Secretary and General Manager, Board of Public Works, Grand Rapids, Mich.........1906

Cutter, A. B. City Engineer, Everett, Wash.........1917

Dallyn, Frederick A., Provincial Sanitary Engineer, Province of Ontario, Parliament Buildings, Toronto, Ont., Can.........1915

Dalton, E. L., Consulting Engineer, 9–10 Murphy Building, Dallas, Tex.........1906

Darcey, Henry J., State Sanitary Engineer, State Laboratory, 401 East 2d St., Oklahoma City, Okla.........1921

Darling, B. F., Supervising Engineer, Bureau of Relief Sewers, City Building, Lima, Ohio.........1922

Datz, L. C., Chief Engineer, Memphis Power and Light Company, Memphis, Tenn....1923
Davis, Carl E., Engineer for Commission, Memphis Artesian Water Department, 105 N. 2d Street, Memphis, Tenn....1923
Davis, D. B., City Engineer, Richmond, Ind....1918
Davis, E. Russell, Chief Engineer, Court House, Newport News, Va....1919
Dea, Joseph C. O., Assistant Engineer, 210 Albemarle Road, Brooklyn, N. Y....1923
Decker, A. Clinton, Mayor, Fairfield, Ala....1920
De Frees, F. B., Deputy County Surveyor, 1442 Harvard Bldg., Toledo, Ohio....1922
De Lay, Theodore S., Consulting Engineer, Creston, Iowa....1910
De Leuw, Charles E., Kelker, Gates and De Leuw, 1206 Conway Building, Chicago, Ill....1920
Dingle, James H., City Engineer, City Hall, Charleston, S. C....1908
Dixon, G. Gale, Consulting Engineer, 400 Finance Building, Cleveland, Ohio....1922
Doremus, Goline, Engineer in Charge Bureau of Street Cleaning, Department of Streets and Public Improvements, City Hall, Newark, N. J....1920
Dorr, Edgar S., Engineer in Charge of Special Work, Sewer Service, 707 City Hall Annex, Res. 213 Savin-Hill Ave., Boston 25, Mass. 1914
Doughty, Joshua, Jr., Town and County Engineer, Somerville, N. J....1918
Douthitt, M. J., City Engineer, City Hall, Waukegan, Ill....1911
Dow, A. W., Consulting Engineer, Dow and Smith, 131 E. 23d St., New York City....1899
Drake, Edward, Consulting Engineer, Ocala, Fla....1922
Drake, W. O., City Engineer and Superintendent Department of Public Works, City Hall, Corning, N. Y....1921
Drinkwater, Ernest, City Engineer, 588 Desaulniers Blvd., St. Lambert, Que. Canada....1918
Drowne, Henry B., 40 Converse St., Long Meadow, Mass....1912
Duck, Allen Douglas, Consulting Engineer, Box 218, Greenville, Tex....1913
Dunham, Jr., William R., Executive Engineer Dept. of Street Railways, Shoemaker & St. Jean Sts., Detroit, Mich....1922
Dunlap, Fred C., Chief of Bureau of Highways, City Hall, Philadelphia, Pa....1915
Durham, Henry Wells, Consulting Engineer, Sandwich, Mass....1913
Dutton, E. R., Assistant City Engineer, 3240 Dupont Ave., Minneapolis, Minn....1914

Eager, George, Supervisor of Roads, Essex County, Millburn, N. J....1916
Eagle, W. H., Superintendent of Municipal Asphalt Plant, City Hall, Columbus, Ohio....1919
Earl, George G., General Superintendent Sewerage and Water Board, New Orleans, La....1906
Earle, Roscoe K., City Engineer, 606 E. 8th St., Davenport, Iowa ...1920
Eddy, Harrison P., Metcalf and Eddy, Consulting Civil Engineers, 14 Beacon St., Boston, Mass....1914
Eichelberger, F. O., City Manager, Dayton, Ohio....1915
Elliott, John L., City Civil Engineer, City Hall, Indianapolis, Ind....1922
Ellsworth, Frank VP., Southwestern Engineering Company, Texarkana, Ark....1908
Elsberg, N. W., City Engineer, Minneapolis, Minn....1922
Emerson, Jr., C. A., Fuller and McClintock, 1001 Chestnut St., Philadelphia, Pa....1917
Emerson, Guy C., Consulting Engineer, Boston Finance Commission, 73 Tremont St., Boston, Mass....1922
Emerson, Lewis A., Secretary-Treasurer Tomlinson Engineering Company, 1002 Loan and Exchange Building, Columbia, S. C....1920

Emmart, Wm. M., Consulting City Planner, 1101 Union Trust Building, Baltimore, Md. 1921
Evans, M. S., Director of Tests, Department of Public Works, Center and Dethridge Sts., Pittsburg, Pa. 1918
Evinger, Morris I., Station A, Lincoln, Neb. 1918

Fairtrace, George D., Civil Engineer, Dallas, Tex. 1919
Farrell, Frank D., Superintendent of Street Lighting, Bureau of Streets, Municipal Building, Buffalo, N. Y. 1922
Ferebee, James L., Principal Assistant Engineer, Sewerage Commission, City Hall, Milwaukee, Wis. 1921
Ferver, A. L., City Engineer, Long Beach, Calif. 1922
Filby, E. L., State Sanitary Engineer, State Board of Health, Columbia, S. C. 1921
Finch, B. K., City Engineer, Wilkes-Barre, Pa. 1908
Finck, George E., Highways Engineer, 120 Schenck St., Greensboro, N. C. 1921
Fisher, E. A., City Engineer, City Hall, Lakewood, Ohio 1917
Fisher, E. A., Consulting Engineer and Superintendent of City Planning, Rochester, N. Y. 1897
Fisk, George F., Assistant Engineer in Charge of Pavement Construction, Bureau of Engineering, Department of Public Works, 20 Municipal Building, Buffalo, N. Y. 1916
Fletcher, Austin B., Director State Department Public Works, Forum Building, Sacramento, Cal. 1912
Fletcher, Herbert E., Consulting Engineer, West Chelmsford, Mass. .. 1921
Flood, Walter H., 22 Quincy St., Chicago, Ill. 1918
Folwell, A. Prescott, Municipal Engineering Consultant, Park Row Building, New York City 1901
Fowler, William B., City Engineer, Memphis, Tenn. 1917
Fox, Robert L., Engineer, 37 E. Broad St., Bethlehem, Pa. 1920
Francisco, Ellsworth, Engineer in Charge of Bureau of Public Lighting, 204 City Hall, Newark, N. J. 1922
Freire, Victor da Silva, City Chief Engineer, P. O. Box 18, Sao Paulo, Brazil 1922
Freitas, George H., City Engineer, Modesto, Calif. 1913
Friedrich, Frank X., Commissioner of Streets and Public Improvements, Joliet, Ill. 1921
Frommer, Charles, Acting Chief of Bureau of Surveys, Philadelphia, Pa. 1921
Fruen, A. B., Alderman, 45 Chamber of Commerce, Minneapolis, Minn. 1922
Fuess, W. W., Secretary Northern Road Improvement District, Stuttgart, Ark. 1919
Fuller, George W., Consulting Engineer, 170 Broadway, New York City 1906

Gage, Robert B., Chemical Engineer State Highway Commission, Taylor Place, Trenton, N. J. 1920
Gainey, W. H., City Engineer, Valdosta, Ga. 1906
Galligan, William J., Assistant Superintendent of Streets in Charge of Street and Alley Cleaning, 408 City Hall, Chicago, Ill. 1922
Garges, S. J., Commissioner of Public Works, City Hall, New Rochelle, N. Y. 1919
Garvin, Edgerton Chester, Director of Public Works, City Hall, St. Petersburg, Fla. 1919
Gascoigne, George B., Consulting Engineer, 648 Leader-News Building, Cleveland, Ohio 1922
Gaymon, D. F., City Engineer, Pueblo, Colo. 1920
Gaynor, Keyes C., 525–7 Trimble Building, Sioux City, Iowa 1911

George, Howard H., Engineer Maintenance of Way Public Service Corporation, Public Service Terminal, Newark, N. J. 1921
Giesey, Jesse K., Shrewsbury, Pa. 1922
Giles, John A., Hoadley and Giles, Civil Engineers, 415 Phelps Bank Building, Binghamton, N. Y. 1911
Gillen, Charles P., Mayor, Newark, N. J. 1914
Gillette, Halbert P., Consulting Appraisement Engineer, Editor Engineering and Contracting, 9 S. Clinton St., Chicago, Ill. 1919
Gladding, R. D., Consulting Engineer, Wilson, N. C. 1922
Goob, Charles F., Highway Engineer, City Hall, Baltimore, Md. 1921
Goslau, Justus, Chemist to Newark Department of Public Improvements, Cedar Grove, N. J. 1919
Gottschalk, L. F., Special Engineer for City and County, Columbus, Neb. 1918
Graf, Walter W., City Engineer, City Hall, Lancaster, Ohio. 1922
Graham, Frank P., Boro and County Engineer, Grove City, Pa. 1922
Gray, E. R., City Engineer, Hamilton, Ont., Canada. 1916
Greeley, Samuel A., Pearse, Greeley and Hansen, Consulting Engineers, 39 W. Adams St., Chicago, Ill. 1919
Green, Howard R., Consulting Engineer, 634–5 Cedar Rapids Savings Bank Bldg., Cedar Rapids, Iowa. 1919
Gregory, John H., Consulting Engineer, Professor of Civil and Sanitary Engineering, The Johns Hopkins University, Homewood, Baltimore, Md. 1921
Grier, R. Henry, Director, Street and Sewer Department, 1610 Franklin St., Wilmington, Del. 1919
Griffin, John A., City Engineer, 405 S. City Hall Annex, Los Angeles, Cal. 1920
Griffith, Lawrence A., Consulting Engineer Westchester County Transit Commission, Yonkers, N. Y. 1920
Griggs, Charles E., City Engineer, 212 E. Jasper St., Tulsa, Okla. 1919
Grinnalds, Jefferson C., City Planning and Zoning Consultant, Baltimore, Md. 1921

Hackney, John W., City Engineer, 141 St. Charles Place, Atlantic City, N. J. 1908
Hamley, S. J., District Manager, Pittsburg Testing Laboratory, 520 National Building, Cleveland, Ohio. 1917
Hammersley, W. P., Town Manager, 18 Marion Ave., Norwood, Mass. 1919
Hammond, George T., Consulting Engineer, 156 Berkeley Place, Brooklyn, N. Y. 1908
Hanna, Wesley S., Deputy City Comptroller, City Hall, Baltimore, Md. 1921
Hansell, Jr., William A., Supt. of Construction, Department of Public Works, City Hall, Atlanta, Ga. 1916
Hansen, Paul, Pearse, Greeley and Hansen, Hydraulic and Sanitary Engineers, 39 W. Adams St., Chicago, Ill. 1913
Harper, E. F., City Engineer, East St. Louis, Ill. 1920
Harper, Leon L., Consulting Engineer, City Hall, Quincy, Ill. 1922
Harrigan, D. D., City Engineer, San Antonio, Tex. 1923
Harris, Harry F., Mercer County Engineer, Trenton, N. J. 1910
Harris, R. C., Commissioner of Works, Toronto, Ont., Canada. 1914
Hatton, T. Chalkley, Chief Engineer of Sewerage Commission, City Hall, Milwaukee, Wis. 1903
Hawkins, A. J., City Engineer, City Hall, Birmingham, Ala. 1922
Hawkins, C. L., Engineer Way and Structures, United Railways Co., 3869 Park Ave., St. Louis, Mo. 1920
Hawley, John B., Consulting Engineer, 403 Cotton Exchange Building, Ft. Worth, Tex. 1912

Hawley, John B., Highway Engineer, U. S. Bureau of Public Roads, 416 Independent Life Building, Nashville, Tenn. ... 1917

Hayden, Richard J., District Foreman, Boston Park Department, 16 Cobden St., Boston, Mass. ... 1922

Haylow, J. H., Chief Engineer Memphis Street Railway Co., Memphis, Tenn. ... 1923

Heebink, G. E., City Engineer, Goodwin Block, Beloit, Wis. ... 1917

Heimbuecher, W. A., City Engineer, University City, Mo. ... 1920

Helland, Hans, City Engineer, 1109 McCullough Ave., San Antonio, Tex. ... 1917

Helland, H. R. F., City Engineer and Water Superintendent, City Hall, Waxahachie, Tex. ... 1920

Hellen, C. J., Director of Educational Management, Department of Education, Madison and Lafayette Aves., Baltimore, Md. ... 1922

Hering, Rudolph, Consulting Engineer, 1 West 70th St., New York City, N. Y. ... 1910

Herrman, August, Wiggins Block, Cincinnati, Ohio ... 1894

Higgins, E. L., Mayor, Hutchinson, Minn. ... 1923

Highland, Scotland G., General Manager Water Board, Clarksburg, W. Va. ... 1921

Hill, C. D., Engineer Board of Local Improvements, 207 City Hall, Res. 1730 W. 104th St., Chicago, Ill. ... 1920

Hill, Jr., Nicholas S., Consulting Engineer, 112 E. 19th St., New York City, N. Y. ... 1911

Hills, George B., George B. Hills Co., Consulting Engineer, 36 Barnett Building, Jacksonville, Fla. ... 1913

Hittell, John B., District Engineer The Asphalt Association, 729 Hearst Bldg., Chicago, Ill. ... 1908

Hoffman, Robert, Chief Engineer Department of Public Service, Cleveland, Ohio ... 1908

Holmes, Glenn D., Chief Engineer Sewer Board, 104 City Hall, Syracuse, N. Y. ... 1922

Hoover, Clarence B., Superintendent Division of Water and Sewerage, City Hall, Columbus, Ohio ... 1917

Horner, W. W., Chief Engineer Sewers and Paving, 300 City Hall, St. Louis, Mo. ... 1915

Howard, J. W., Consulting Paving Engineer and Testing Laboratory, 234 Mt. Prospect Ave., Newark, N. J. ... 1901

Howe, H. N., Commissioner, Memphis, Tenn. ... 1923

Howe, S. B., City Engineer, 220 S. Grange Ave., Sioux Falls, S. D. ... 1920

Howe, William E., County Engineer, Erie, Kans. ... 1918

Howell, Carl L., 7 Municipal Building, Buffalo, N. Y. ... 1914

Howell, Robert B., General Manager Metropolitan Water District, Omaha, Neb. ... 1920

Hubbard, Prevost, Chemical Engineer The Asphalt Association, 25 W. 43d St., New York City ... 1913

Hudson, Leo, Consulting Hydraulic and Sanitary Engineer, Box 14, Boston, Allegheny County, Pa. ... 1911

Hughes, Charles W., Civil Engineer, 2147 Fifth St., Port Arthur, Tex. ... 1920

Hughes, Hector James, Dean of the Harvard Engineering School, Harvard University, Cambridge, Mass. ... 1914

Hull, Ralph R., Building Commissioner, Municipal Building, Buffalo, N. Y. ... 1922

Hunter, Lionel McL., Roadway Engineer, City Engineer's Office, 7 Willard Ave., Ottawa, Ont., Canada ... 1916

Hyatt, J. S., Engineer Maintenance of Way, Chicago, North Shore & Milwaukee R.R., Highwood, Ill. ... 1923

Jackson, Frank H., Senior Assistant Testing Engineer, Bureau of Public Roads, Washington, D. C.................................1922
Jaudon, H. S., Consulting and Supervising Engineer, Box 582, Elberton, Ga...1920
Jervey, J. P., City Manager, Portsmouth, Va.......................1922
Jewell, Albert H., Chief Engineer State Board of Health, Lawrence, Kan...1921
Johnson, A. L., Street and Sewer Director, Wilmington, Del.........1921
Johnson, E. C., Chief Engineer Pacific Electric Railway Co., 694 Pacific Electric Bldg., Los Angeles, Cal.........................1923
Johnson, George A., George A. Johnson Co., Consulting Engineers, 150 Nassau St., New York City.................................1917
Jones, Harvey P., Engineer in charge of Office of Fuller and McClintock, Consulting Engineers, 317 Summit-Cherry Building, Toledo, Ohio...1922
Jones, Maurice L., City Engineer and Superintendent of Public Works, 368 Washington St., Benton Harbor, Mich......................1920
Jones, Woolsey F., Engineer Birmingham Realty Co., 2118 First Ave., Birmingham, Ala...1921
Judson, Clayton O., City Engineer, 1811 Faraon St., St. Joseph, Mo...1919
Judson, William Pierson, Consulting Engineer, President Broadalbin Electric Light and Power Co., Broadalbin, Fulton County, N. Y...1902

Keefer, Clarence E., Assistant Designing Engineer, Sewer Division, 311 Courtland St., Baltimore, Md................................1922
Kehler, S. I., Associate Civil Engineer, 202 City Hall, Baltimore, Md...1921
Kemmler, E. A., Highway Engineer, 300 Delaware Building, Akron, Ohio...1922
Kendrick, Julian, Consulting Engineer, 606 First National Bank Building, Birmingham, Ala...1898
Kershaw, G. Bertram, Consulting Engineer, 9 Victoria St., Westminster, London, S. W., England.................................1918
Kingsley, Edgar A., City Engineer, Dallas, Tex.....................1908
Kinsey, E. R., President Board of Public Service, St. Louis, Mo.....1920
Kirkpatrick, Walter G., 531 Candler Building, Atlanta, Ga..........1912
Kirschbraun, Lester, Consulting Engineer, 160 N. Wells St., Chicago, Ill..1909
Kleeberg, Felix, Chemist, Department of Public Works, Municipal Building, New York City......................................1915
Klorer, John, City Engineer, New Orleans, La......................1921
Klyce, B. H., 720 Fourth and First National Bank Building, Nashville, Tenn..1913
Knowles, Morris, President Morris Knowles, Inc., Consulting Engineers, 318 Westinghouse Bldg., Pittsburg, Pa...............1922
Koester, Edwin F., Engineer in Charge of Surveying, 1917 Washington St., Wilmington, Del..1921
Koiner, C. W., City Manager, Pasadena, Cal........................1913
Kramer, Xavier A., Consulting Engineer, Magnolia, Miss............1917
Krieger, A. A., Chief Engineer, City Hall, Louisville, Ky...........1921

Lalonde, J. A., Assistant Superintendent of Streets, City Hall, Montreal, Que., Can..1921
Laurgaard, O., City Engineer, Portland, Oregon....................1922
Lawrence, E. A., Jennings-Lawrence Co., 511–12 Hartman Building, Columbus, O..1915
Lee, B. M., City Engineer, Asheville, N. C..........................1908
Lee, R. B., City Engineer, 105 First St. E., Hutchinson, Kans. 1918

Legaré, T. Keith, District Manager Dow and Smith, Sales Engineer Shearman Concrete Pipe Company, 1327 Main St., Columbia, S. C..1919
Leland, Arthur, Supervisor of Recreation, Playground Architect, Newport, R. I...1919
Lenderink, Andrew, Consulting Engineer, 501 Kalamazoo National Bank Bldg., Kalamazoo, Mich.....................................1912
Lenhardt, L. G., City Engineer, Pontiac, Mich.......................1922
Lewis, E. T., Commissioner of Streets and Sewers, City Hall, Nashville, Tenn...1921
Lewis, Nelson P., Consulting Engineer, 130 E. 22d St., New York City...1895
Lindsten, Gottfried T., Alderman, City Council, 2122 N. Bryant Ave., Minneapolis, Minn...1921
Lingley, Ralph G., Superintendent of Sewer Department, 31 City Hall, Worcester, Mass..1920
Linville, Ralph K., City Engineer, Danville, Va.....................1920
Little, John C., The Development and Construction Company, 506 American Building, Baltimore, Md............................1910
Lovewell, Maurice N., Assistant Engineer, South Park Commission, 57th and Cottage Grove Ave., Chicago, Ill......................1912
Luster, W. H., Elizabeth, N. J.......................................1905

Macallum, Andrew F., Commissioner of Public Works, Ottawa, Ont., Can...1909
MacDonald, James H., Road and Pavement Expert, Temple and Chapel Sts., New Haven, Conn.....................................1914
MacDonald, Walter Elwood, City Water Works Engineer, 21 Fourth Ave., Ottawa, Ont., Can...1919
MacGregor, R. A., Assistant Engineer Department of Public Works, Boro of Manhattan, Municipal Building, New York City.........1915
Mackscy, H. V., Superintendent of Public Works, Framingham, Mass..1921
Maetzel, Henry, Paving Engineer, Street Railway Company, 165 E. Deshler St., Columbus, O.......................................1908
Mahnken, Alfred J., Civil and Constructing Engineer and Contract Manager, 95 River St., Hoboken, N. J...........................1917
Mahoney, Arthur J., City Engineer, Clifton, N. J....................1923
Mahony, J. J., City Clerk, St. Johns, Newfoundland.................1921
Maier, Harry L., Chief Engineer, 229 Connell St., Wilmington, Del. .1919
Makino, U., Civil Engineer, Bureau of Public Works, Japanese Home Department, Tokio, Japan..1919
Mallette, John S., Municipal Engineer, Reed Building, Ravenna, O. 1922
Malone, James, City Engineer, Department of Streets and Public Improvements, Sioux City, Iowa..................................1920
Mangold, John F., Armour Institute of Technology, Chicago, Ill.....1913
Mansfield, M. G., Division Engineer Morris Knowles, Inc., 1200 Jones Bldg., 7046 Penn. Ave., Pittsburg, Pa...........................1923
Markwell, Kenneth, Chief Draftsman City Engineer Department, Memphis, Tenn...1923
Marston, F. A., Metcalf and Eddy, 14 Beacon St., Boston, Mass. ...1922
McArthur, Franklin, City Engineer, Guelph, Ont., Canada...........1916
McClelland, Richard J., City Engineer, Kingston, Ont., Canada. 1917
McClintock, J. R., Fuller and McClintock, 421 Produce Exchange Building, Kansas City, Mo..1922
McComb, Dana Quick, Chief Engineer State Highway Department, Nashville, Tenn...1917
McElroy, James A., City Engineer, City Hall, Bridgeport, Conn.....1920
McKellip, F. W., City Engineer, Faribault, Minn....................1918
McVea, J. C., City Engineer, Houston, Tex..........................1919
McWhorter, A. D., Superintendent Equipment and Overhead Lines, Memphis Street Railway Co., Memphis, Tenn....................1923

Meade, R. E., P. O. Box 94, Florence, Ala..........1906
Mebus, Charles F., Albright and Mebus, Consulting Engineers, 1502 Locust St., Philadelphia, Pa..........1920
Megraw, Wm. A., President Water Board and Water Engineer, City Hall, Baltimore, Md..........1921
Mentz, H. A., Principal Assistant Engineer of X. A. Kramer, Magnolia, Miss..........1919
Metz, L. V., Civil Engineer, Erie, Pa..........1910
Meyers, Dudley C., Commissioner of Public Works, Municipal Building, Oak Park, Ill..........1923
Miller, Chalmers C., City Engineer, City Hall, Lorain, Ohio..........1919
Miller, Donald C., Chief Clerk, Department of Streets, Sewers and Bridges, Memphis, Tenn..........1923
Miller, G. M., Superintendent of Electrical Distribution and Construction, Louisville Gas and Electric Company, 715 W. Ormsby Ave., Louisville, Ky..........1922
Miller, H. E., Director Bureau of Sanitary Engineering, State Board of Health, Raleigh, N. C..........1921
Mitchell, Lequin, City Manager, Lufkin, Tex..........1919
Monroe, Lowell W., Assistant City Engineer, Meadville, Pa..........1921
Montgomery, Julian, City Engineer, Wichita Falls, Tex..........1920
Morales, Luis, Consulting Engineer, Architect and General Contractor, Aguiar No. 84, Havana, Cuba, Res. F entre 13 y 15 Vedado, Havana, Cuba..........1917
Morath, Ben J., Deputy Commissioner of Public Property, 18 City Hall, New Orleans, La..........1922
Morse, Robert Brooks, Chief Engineer of Washington Suburban Sanitary District, Hyattsville, Md..........1921
Mullen, Charles A., Consulting Paving Engineer, Director of Paving Department Milton Hersey Co. Ltd., 84 St. Antoine St., Montreal, Que., Can..........1911
Murray, Charles W., City Engineer, Miami, Fla..........1918
Mussina, Lyons, City Engineer, Williamsport, Pa..........1921
Myers, William G., City Engineer, Harrisonburg, Va..........1916

Naylor, A. W., City Engineer, Navasota, Tex..........1921
Near, W. P., City Engineer, London, Ont., Canada..........1915
Nevitt, J. H., Engineer in Charge of Main Sewage Disposal, 348 Lake Front, Toronto, Ont., Canada..........1920
Newton, S. D., Cleveland, Tenn..........1913
Nixon, Henry, Deputy Commissioner of Electricity, 614 City Hall, Chicago, Ill..........1923
Noble, O. E., Municipal Engineer, Norton, Kan..........1908
Norton, George H., City Engineer, 20 Municipal Building, Buffalo, N. Y..........1914
Nutting, H. C., H. C. Nutting Company, Hunt and Broadway, Cincinnati, Ohio..........1919

Oakes, Henry G., City Engineer, Muskegon Heights, Mich..........1920
O'Leary, Arthur L., Commissioner of Streets and Public Improvements, East St. Louis, Ill..........1920
Olmsted, Frederick L., Landscape Architect, Brookline, Mass..........1909
O'Neil, Perry, Hydraulic and Sanitary Engineer, 715-6 Praetorian Building, Dallas, Texas..........1922
Osborn, C. M., City Manager, City Hall, Kenosha, Wis..........1922
Osgood, Manley, Ann Arbor Asphalt Construction Co., 716 National Bank Bldg., Ann Arbor, Mich..........1914
Overland, Arthur B., City Engineer, Austin, Minn..........1919

Pace, M. D., City Engineer, Troy, Ala..........1920
Painter, Pennell C., City Manager, Greensboro, N. C..........1921

Pape, F. W., Park Commissioner, St. Louis, Mo.....................1920
Parent, Arthur, Superintendent of City Lighting Department, Montreal, Que., Can.....................1905
Parker, E. E., City Engineer, Madison, Wis.....................1917
Parker, G. A., Secretary and Treasurer State Park Commission, Superintendent of Parks, Municipal Building, Hartford, Conn.........1902
Pashby, C. C., Clerk of County Commissioners, Memphis, Tenn. ...1923
Patterson, C. A., City Engineer, City Hall, Torrington, Conn.......1921
Patzig, Monroe L., Consulting Paving Engineer, 206–10 Eleventh St., Des Moines, Ia.....................1918
Pearse, Langdon, Sanitary Engineer, the Sanitary District of Chicago, 910 S. Michigan Ave., Chicago, Ill.....................1919
Peck, Leon F., Superintendent of Streets, Municipal Building, Hartford, Conn.....................1913
Perrine, J. Franklin, Engineer of Sewers, Queens Subway Building, Long Island City, N. Y.....................1921
Perring, H. G., Supervising Engineer of Public Improvement Commission, City Hall, Baltimore, Md.....................1921
Phillips, Roy L., City Engineer, Meadville, Pa.....................1919
Phul, William von, Member of Ford, Bacon and Davis, 115 Broadway, New York City.....................1911
Pierce, Herbert W., Commissioner of Public Works, 26 City Hall, Rochester, N. Y.....................1914
Pierson, Frank W., Secretary Board of Directors, Street and Sewer Department, Wilmington, Del.....................1915
Pitzman, Julius, City Surveyor, St. Louis, Mo.....................1920
Pollock, Clarence D., Consulting Engineer, Park Row Building, New York City.....................1902
Poole, C. Arthur, City Engineer, City Hall, Rochester, N. Y.........1918
Porter, John L., Director Water Purification Stations, 8407 Panola St., New Orleans, La.....................1919
Potter, Alexander, Consulting Civil Engineer, 50 Church St., New York City.....................1922
Powell, John M., City Engineer, Elyria, Ohio.....................1922
Powell, Sheppard T., Chemist Baltimore County Water and Electric Company, 100 W. Fayette St., Baltimore, Md.....................1921
Proctor, Edward M., James, Proctor and Redfern, Consulting Engineers, 36 Toronto St., Toronto, Ont., Canada...............1920

Rankin, E. S., Engineer in Charge, Bureau of Sewers, City Hall, Newark, N. J.....................1903
Ray, Clare M., City Engineer, Kokomo, Ind.....................1920
Raymond, T. L., Director Department of Streets and Public Improvements, City Hall, Newark, N. J.....................1919
Reed, Tom M., Assistant Chief Engineer Streets, Playgrounds and Parks, 17 E. Lacock St., Pittsburg, Pa.....................1918
Reese, C. A., City Engineer, Easton, Pa.....................1922
Reid, John W., City Engineer, City Hall, Detroit, Mich..............1922
Reimer, Frederic A., Engineer The Asphalt Association, New Jersey Branch, Reimer, Freeman and Winston, Consulting and Civil Engineers, 40 Clinton St. N., Newark, N. J.....................1909
Reppert, Charles M., Chief Engineer Bureau of Engineering, Department of Public Works, 421 City-County Building, Res. 5538 Bartlett St., Pittsburg, Pa.....................1921
Requardt G. J., Consulting Engineer, 615 Munsey Building, Baltimore, Md.....................1921
Reynolds, A. M., Chief Engineer of Essex County Park Commission, 115 Clifton Ave., Newark, N. J.....................1908
Rice, John M., Engineer, 411 Oliver Building, Pittsburg, Pa..........1918

Ridgway, Robert, Chief Engineer Transit Commission, 49 Lafayette St., New York City.....1908
Ridley, Clarence E., City Manager, Bluefield, W. Va.....1919
Robertson, E. B., Water Commissioner, Stevens Point, Wis.....1922
Rochford, Harry T., Assistant Engineer of Pavement Maintenance, Municipal Building, Buffalo, N. Y.....1922
Rogers, Niart, City Engineer, Asbury Park, N. J.....1909
Rolfe, W. E., Associate to President, Board of Public Service, St. Louis, Mo.....1920
Root, Joseph E., Sewerage Engineer, Department of Public Service, Delaware Bldg., Akron, Ohio.....1915
Rose, Alston O., Consulting Engineer, Morris Knowles, Inc., 662 Hanna Building, Cleveland, Ohio.....1922
Roskelley, Charles O., City Manager, Brigham City, Utah.....1922
Ross, James A., County Supervisor of Roads, 4 Southard St., Trenton, N. J.....1919
Routh, James W., Consulting Engineer, 1294 Lincoln Ave., St. Paul, Minn.....1916
Rowland, H. A., City Engineer, McPherson, Kans.....1917
Ruch, William A., Commissioner of Highways, City Hall, Allentown, Pa.....1920
Rudolph, Charles A., 900 Van Buren St., Wilmington, Del.....1912
Rust, Charles H., Toronto Electric Light Co., 12 Adelaide St. E., Toronto, Ont., Can.....1898
Ryder, Ely M. T., Way Engineer, Third Ave. Railway Co., 2396 3d Ave., New York City.....1922

Sammelman, Sylverius, General Manager Advance Motors Co., 2929 Locust St., St. Louis, Mo.....1915
Sargent, George H., City Engineer, La Grange, Ga.....1918
Sarver, William Edward, City Engineer, Canton, Ohio.....1915
Saville, A. J., Director of Public Works, City Hall, Richmond, Va.....1921
Sawyer, Walter H., Sawyer and Bean, Hydraulic Engineers, 11 Lisbon St., Lewiston, Me.....1918
Scacciaferro, S. John, Civil and Sanitary Engineer, 506 Highland Ave., Clifton, N. J.....1921
Schaetzle, T. C., Principal Sanitary Chemist, Baltimore Sewage Treatment Works, 37 Rueckert Ave., Baltimore, Md.....1922
Schmitt, Jacob, Chief Engineer of Highways, 50 Court St., Brooklyn, N. Y.....1922
Schott, A. M., Engineer, Sioux City, Iowa.....1920
Schultz, Charles, City Engineer, Tulsa, Okla.....1923
Schutt, Harold G., Assistant City Manager, Bluefield, W. Va.....1921
Schwartz, William F., Street Commissioner, 64 Franklin St., Buffalo, N. Y.....1919
Schweizer, Rudolph, Jr., Village Engineer, 20 Edwin St., Ridgfield Park, N. J.....1920
Schwemler, Frank J., Assistant County Engineer, New Court House, Cleveland, Ohio.....1922
Sessions, R. L., Civil Engineer, Office of City Manager, Dayton, Ohio.....1922
Seward, Oscar A., Jr., City Engineer and Chief Engineer of Wharf and Dock Commission, Beaumont, Tex.....1921
Shaner, H. L., Commissioner of Public Works, City Hall, Winston-Salem, N. C.....1908
Shaw, Walter A., Consulting Engineer, 30 N. La Salle St., Chicago, Ill.....1922
Sheaf, Fred W., Mayor, Rutherford, N. J.....1917
Sheahan, James, General Superintendent, Water Department, Memphis, Tenn.....1923

Sheddan, W. E., City Engineer, City Engineer Building, Jacksonville, Fla. 1922

Shelton, William H., City Engineer, 617 Central Ave., Dunkirk, N. Y. 1916

Shepard, Frank T., Town Engineer of Belleville, 352 Center St., Nutley, N. J. 1920

Shepheard, Fred H., Assistant Engineer, Boro Hall, Long Island City, N. Y. 1922

Sherrerd, Morris R., Chief Engineer Department of Streets and Public Improvements, City Hall, Newark, N. J. 1896

Shifrin, Hymen, Engineer Department of Sewers and Paving, 300 City Hall, St. Louis, Mo. 1922

Shirley, Henry G., Roads and Sanitary Engineer Baltimore County, Towson, Md. 1921

Shirley, Joseph W., Chief Engineer Topographical Survey Commission, Baltimore, Md. 1921

Shupe, Stanley, City Engineer, City Hall, Kitchener, Ont., Can. 1923

Siems, V. Bernard, Associate Civil Engineer, Water Department, Baltimore, Md. 1921

Simons, George W., Jr., Chief Sanitary Engineer State Board of Health, Jacksonville, Fla. 1922

Simpson, Arthur J., Engineer Bureau of Docks, Department of Streets and Public Improvements, City Hall, Newark, N. J. 1920

Skidmore, Hugh W., President Chicago Paving Laboratory, Inc., 160 N. Wells St., Chicago, Ill. 1921

Skinner, John F., Principal Assistant City Engineer, Rochester, N. Y. . 1921

Smith, Benjamin Le Compte, Member Norton, Bird and Whitman, Engineers, 615 Munsey Building, Baltimore, Md. 1922

Smith, Francis P., Consulting Engineer, Dow and Smith, 131–133 E. 22d St., New York City. 1908

Smith, Herman H., Deputy Chief Engineer, Board of Estimate and Apportionment, 1347 Municipal Building, New York City. 1915

Smith, Nathan L, Associate Civil Engineer of Highways, Paving Commission, 4110 Belle Ave., Baltimore, Md. 1921

Snyder, Frederick Antes, Res. Engineer, N. Y. - N. J. Vehicular Tunnel, 105 Carnegie Ave., East Orange, N. J. 1914

Southgate, W. W., City Engineer, City Hall, Nashville, Tenn. 1920

Spencer, A. T., Engineer of Way, Toronto Transportation Comsion, Toronto, Ont., Can. 1923

Sperry, Walter A., Director of Public Service, City Hall, Grand Rapids, Mich. 1922

Sprague, Norman S., Consulting Engineer, 1104 Bessemer Building, Pittsburg, Pa. 1908

Starks, W. Fred, County Superintendent of Highways, Glen Cove, N. Y. 1917

Steed, Robert E., City Clerk, P. O. Box 919, Norfolk, Va. 1911

Stevenson, John D., Engineer, Division of Bridges, 1231 Monterey St., Pittsburg, Pa. 1912

Stevenson, W. L., Assistant Chief Engineer, State Department of Health, Harrisburg, Pa. 1918

Stickel, W. A., County Engineer, County Court House, Newark, N. J. . 1922

Stoecker, William, Engineer of Maplewood and Webster Groves, St. Louis, Mo. 1920

Storrie, William, Consulting Civil Engineer, 625 Confederation Life Building, Toronto, Ont., Can. 1920

Sullivan, Thomas F., Chairman of Board of Transit Commissioners, 1 Beacon St., Boston, 9, Mass. 1919

Swan, John, Director Department of Public Works, City-County Building, Pittsburg, Pa. 1919

Sweeney, Daniel J., City Clerk, City Hall, Buffalo, N. Y. 1920

Talbot, A. N., Professor of Municipal and Sanitary Engineering, University of Illinois, Urbana, Ill.......1896
Taylor, Paul R., City Manager, Grand Haven, Mich.......1922
Taylor, Walter H., Jr., Director of Public Works, 61 Stockley Gardens, Norfolk, Va.......1917
Taylor, William Verner, City Engineer, Sarnia, Ont., Can.......1922
Thomas, E. J., City Engineer, Minot, N. D.......1919
Thomas, Frank A., Road Engineer, 1383 E. 111th St., Cleveland, Ohio.......1922
Thompson, George W., General Manager, Westmount, Que., Can.......1921
Thorndike, Sturgis H., Fay, Spofford and Thorndike, Consulting Engineers, 200 Devonshire St., Boston, Mass.......1922
Thum, William, 123 Columbia St., Pasadena, Cal.......1912
Tillson, George W., Consulting Engineer, 313 S. Catherine Ave., La Grange, Ill.......1897
Toensfeldt, Ralph, Engineer Division of Lighting, St. Louis, Mo.......1920
Tolles, Frank C., 1120 Second National Bank Building, Akron, Ohio..1922
Tomlinson, W. S., City Engineer, Columbia, S. C.......1921
Tremblay, Thomas, City Engineer, 30 Peel St., Sherbrooke, Que., Can..1919
Tribus, Louis L., Tribus and Massa, Consulting Engineers, 15 Park Row, New York City.......1908
Truss, J. D., 7827 Underwood Ave., Birmingham, Ala.......1917
Turner, J. W., Consulting Highway Engineer, Lakeland, Fla.......1917
Tuska, Gustave R., Consulting Engineer, 68 William St., New York City.......1915
Tutwiler, T. H., Pres. Memphis Street Railway Company and Memphis Power and Light Company, Memphis, Tenn.......1923

Ulrich, Edmund B., City Engineer, Reading, Pa.......1914
Underwood, C. H., City Chemical Engineer, City Hall, Indianapolis, Ind.......1922

Van Duyne, Harrison R., Deputy Chief Engineer, City Hall, Newark, N. J.......1920
Van Etta, C. J., Superintendent of Street Construction and Repair, Department of Public Works, 705 39th St., Milwaukee, Wis.......1919
Van Trump, Isaac, Consulting Asphalt Engineer, 2337 S. Paulina St., Chicago, Ill.......1911
Varney, Henry A., Town Engineer, 25 Town Hall, Brookline, Mass.......1916
Vars, Alexander, City Engineer, 814 Webster Place, Plainfield, N. J..1916
Vaughn, W. A., Civil and Testing Engineer, 143 W. Main St., Evansville, Wis.......1921
Veatch, N. T., Jr., Black and Veatch, Consulting Engineers, Mutual Building, Kansas City, Mo.......1920
Vogelson, John A., Chief Engineer, Bureau of Surveys, City Hall, Philadelphia, Pa.......1922
Von Zuben, Frank J., Baker and Von Zuben, Municipal Engineers and Surveyors, Ft. Worth, Tex.......1912

Waddell, Robert W., City Engineer, City Hall, Kansas City, Mo.......1918
Wagner, C. F., Vice President and Chief Engineer, J. B. McCrary Co., 1408 3d National Bank Building, Atlanta, Ga.......1923
Wagner, Gerald J., Director of Public Service, 1203 Prospect Ave. S., Grand Rapids, Mich.......1919
Wagner, Joseph C., Assistant Director of Public Works, Philadelphia, Pa.......1921
Wahlquist, John, Alderman, 2528 Elliot Ave., Minneapolis, Minn.......1921
Wall, Edward E., Water Commissioner, St. Louis, Mo.......1920
Walter, Albert G., Assistant City Engineer, 614 Main St., Dunkirk, N. Y.......1922

Walters, R. Earle, Boro Engineer, Municipal Building, Tarentum, Pa.	1920
Warden, Herman, Chairman Library Board, Pasco, Wash.	1920
Wasser, Thomas J., State Highway Engineer, Trenton, N. J.	1913
Watson, Robert M., Boro Engineer, Rutherford, N. J.	1908
Weaver, H. J., City Engineer, Elkhart, Ind.	1918
Weber, B. B., City Engineer, City Building, Oil City, Pa.	1917
Webster, Edwin R., Consulting Engineer, 413 Webster Building, 327 S. La Salle St., Chicago, Ill.	1916
Weller, W. Earl, City Engineer, 26 Crary Ave., Binghamton, N. Y.	1921
Wells, John J., Civil and Consulting Engineer, Rocky Mount, N. C.	1921
Wentworth, Russell A., Civil Engineer, Expert on Valuations, Curtis Block, Batavia, N. Y.	1918
Wenzel, Herman C., Commissioner of Public Works, 301 Court House, St. Paul, Minn.	1920
Weston, Robert Spurr, Weston and Sampson, Consulting Engineers, 14 Beacon St., Boston, Mass.	1914
White, Linn, Chief Engineer, South Park Commissioners, 57th St. and Cottage Grove Ave., Chicago, Ill.	1908
Whitman, Ezra B., Public Service Commissioner of Maryland, Baltimore, Md.	1921
Whitten, Robert, City Planning Consultant, 4614 Prospect Ave., Cleveland, Ohio	1922
Willey, Marney B., Nagle, Witt and Rollins Engineering Co., 4030 Junius St., Dallas, Tex.	1919
Willigerod, W. D., City Engineer, City Hall, East Orange, N. J.	1913
Wingfield, Nisbet, Consulting Engineer, 812–4 Marion Building, Augusta, Ga.	1906
Winn, Jr., Thomas E., Engineer in Charge of Paving Construction, Alexander Apartments, W. 4th St., Winston-Salem, N. C.	1919
Winston, Charles A., Engineer, West Orange, N. J.	1920
Wise, B. A., City Engineer, Bradford, Pa.	1916
Wise, Colin R., City Engineer, 301 Gregory Ave., Passaic, N. J.	1915
Wise, Russell S., Wise and Watson, Consulting Engineers, 34 Bloomfield Ave., Passaic, N. J.	1921
Wise, W. H., City Engineer and Commissioner of Public Works, Augusta, Ga.	1922
Withrow, Edgar P., Engineer in charge of Municipal Testing Laboratory, 55 Municipal Courts Building, St. Louis, Mo.	1918
Woermann, John W., Room 1201, 537 S. Dearborn St., Chicago, Ill.	1920
Wolfinger, Wellington R., Contractor and Engineer, Norristown, Pa.	1918
Wolman, Abel, Chief Engineer State Department of Health, Editor in Chief Journal of American Water Works Association, 16 W. Saratoga St., Baltimore, Md.	1921
Wright, B. T., City Engineer, Bedford, Ohio	1922
Wynne-Roberts, R. O., Consulting Engineer, 45 Jarvis St., Toronto, Ont., Can.	1918
Wysor, W. W., Chief Engineer, United Railways and Electric Company, 1507 Continental Bldg., Baltimore, Md.	1921

MUNICIPAL MEMBERS AND THEIR DELEGATES

ALLENTOWN, PA.
H. E. Bascom
W. A. Ruch

AUGUSTA, GA.
W. H. Wise

BALTIMORE, MD.
A. E. Christhilf

BEAUMONT, TEX.
O. A. Seward, Jr.

BEDFORD, O.
B. T. Wright

BINGHAMTON, N. Y.
W. Earl Weller

BRIGHAM CITY, UTAH
C. O. Roskelley

BUFFALO, N. Y.
C. E. P. Babcock
Douglas Cornell
G. F. Fisk
C. L. Howell
G. H. Norton
W. F. Schwartz

DANVILLE, VA.
R. K. Linville

ELIZABETH, N. J.
Thomas E. Collins

ELKHART, IND.
H. J. Weaver

EVERETT, WASH.
A. B. Cutter

FARIBAULT, MINN.
F. W. McKellip

GUELPH, ONT.
Franklin McArthur

HARRISBURG, PA.
M. B. Cowden

HOUSTON, TEX.
J. C. McVea

ILLINOIS STATE WATER SURVEY DIVISION
A. M. Buswell

JOLIET, ILL.
Frank X. Friedrich

KALAMAZOO, MICH.
E. S. Clark

KANSAS CITY, MO.
Robert W. Waddell

KANSAS STATE BOARD OF HEALTH
A. H. Jewell

KITCHENER, ONT.
Stanley Shupe

LOS ANGELES, CAL.
John A. Griffin

LOUISVILLE, KY.
A. A. Krieger

LUFKIN, TEX.
Lequin Mitchell

MEMPHIS, TENN.
M. J. Anderson
C. E. Davis
W. B. Fowler
H. N. Howe
Kenneth Markwell
D. C. Miller
James Sheahan

MINNEAPOLIS, MINN.
Albert Bastis
W. A. Currie
Ellis R. Dutton
G. T. Lindsten
John Wahlquist

MONTREAL, QUE.
Arthur Parent

NEWARK, N. J.
James W. Costello
Goline Doremus
Ellsworth Francisco
Charles P. Gillen
Justus Goslau
Edward S. Rankin
T. L. Raymond
M. R. Sherrerd

NEW ORLEANS, LA.
Wilbert Black
John Klorer
Ben J. Morath

NEW ROCHELLE, N. Y.
S. J. Garges

NORFOLK, VA.
R. E. Steed
W. H. Taylor, Jr.

NORRISTOWN, PA.
S. Cameron Corson

NORWOOD, MASS.
W. P. Hammersley

OAK PARK, ILL.
Dudley C. Meyers

OMAHA, NEB.
Robert B. Howell

ONTARIO, PROVINCE OF,
F. A. Dallyn

PASADENA, CAL.
C. W. Koiner

PASCO, WASH.
Herman Warden

PAWTUCKET, R. I.
George A. Carpenter

PONTIAC, MICH.
L. G. Lenhardt

QUEBEC, QUE.
W. D. Bailliarge

READING, PA.
Edmund B. Ulrich

ROCHESTER, N. Y.
Herbert W. Pierce

RUTHERFORD, N. J.
F. W. Sheaf

ST. JOHNS, NEWFOUNDLAND
J. J. Mahony

ST. LOUIS, MO.
W. W. Horner
E. R. Kinsey
W. E. Rolfe
S. Sammelman
Ralph Toensfeldt

ST. PETERSBURG, FLA.
E. C. Garvin

SALT LAKE CITY, UTAH
Sylvester Q. Cannon

SANDERSVILLE, GA.
John N. Bohannon

SIOUX CITY, IOWA
James Malone

TORONTO, ONT.
R. C. Harris

WESTMOUNT, QUE.
G. W. Thompson

WILKES-BARRE, PA.
B. K. Finch

WILMINGTON, DEL.
R. H. Grier
A. L. Johnson
E. F. Koester
H. L. Maier
F. W. Pierson

WINSTON-SALEM, N. C.
H. L. Shaner

WORCESTER, MASS.
Ralph G. Lingley

AFFILIATED MEMBERS

Anderson, Earl A., Illuminating Engineer, National Lamp Works, Nela Park, East Cleveland, Ohio................................1920

Ballinger, Walter F., The Ballinger Co., Architects and Engineers, S. E. Corner 12th and Chestnut Sts., Philadelphia, Pa.................1918
Bassett, W. A., National Institute of Public Administration, 261 Broadway, New York City..1918

Campbell, John, Superintendent Special Service Department, Edison Electric Illuminating Co., 39 Boylston St., Boston, Mass.........1913
Cross, Roy, Kansas City Testing Laboratory, 700 Baltimore Ave., Kansas City, Mo..1918

Diel, Charles H., Secretary Municipal Development Bureau, Chamber of Commerce, St. Louis, Mo.....................................1920

Farey, F. O., Robert W. Hunt and Co., 905 McGill Building, McGill St., Montreal, Que., Can...1918
Flannigan, E. L., Contractor, Baltimore, Md..........................1921
Follin, James W., Bureau of Municipal Research, 1417 Sansom St., Philadelphia, Pa..1921

Haas, Orville T., National Lamp Works, Nela Park, Cleveland, Ohio.1923
Hadden, Samuel C., Editor Municipal and County Engineering, 702 Wulsin Bldg., Indianapolis, Ind..................................1920
Halfhill, James W., Attorney at Law, 310–16 Cincinnati Blk, Lima, Ohio.1922
Hebden, Edwin K., Engineer for Development and Construction Company, 4221 York Road, Baltimore, Md.......................1921
Holmes, M. E., Chemical Director National Lime Association, 918 G. St., N. W., Washington, D. C.....................................1923

Jenkins, H. S., The White Company, Cleveland, Ohio................1921
Johnson, Helen M., Director Municipal Reference Bureau, Galesburg, Ill..1921

Lothrop, G. W., Woonsocket, R. I..................................1913

Masury, Alfred F., Chief Engineer and Vice President International Motor Co., Sixty-fourth and West End Ave., New York City....1917

Nebraska Legislative Reference Bureau, Library Hall, University of Nebraska, Lincoln, Neb., Edna D. Bullock, Librarian, Rep. 1919
Newcomb, William T., Consulting Highway Engineer, 710 Drake Bldg., Easton, Pa...1922

Olson, F. L., Director of Municipal Research, Civic and Commerce Association, Minneapolis, Minn.................................1919

Place, Arthur Harrington, Engineer Bureau of Governmental Research, 316 E. Jefferson Ave., Detroit, Mich...............................1922
Proctor, Ralph F., Engineer Maryland Casualty Co., Baltimore, Md...1921

San Francisco Bureau of Governmental Research, W. H. Nanry, Rep. 58 Sutter St., San Francisco, Cal.................................1923
Stewart, Frank M., Head of Government Research Division, Instructor in Government, University of Texas, Austin, Tex................1919
Stone, William H., Associate Editor Manufacturers Record, Baltimore, Md...1919
Story, Stephen B., Director of Municipal Research, 310 Aetna Bldg., 25 Exchange St., Rochester, N. Y.................................1921
Sucro, W. G., Engineering and Contracting, 563 Calvert Bldg., Baltimore, Md...1921

Von Schrenk, Hermann, Consulting Timber Engineer, Tower Grove and Flad Aves., St. Louis, Mo......................................1914

Williams, Fred R., Engineer Kentucky Rock Asphalt Co., Cleveland, Ohio...1923

ASSOCIATE MEMBERS

Ahrens, H. F., Jr., Treasurer, Rep. Lock Joint Pipe Co., Leonia, N. J..1921
AMBURSEN CONSTRUCTION COMPANY, INC., Grand Central Terminal, New York City...1921
S. W. Stewart, President, Grand Central Terminal, New York City
AMERICAN CAR SPRINKLER COMPANY, 1 Brussels St., Worcester, Mass..1917
E. D. Perry, Assistant General Superintendent, Box 414, Worcester, Mass.
AMERICAN CITY, THE, 443 Fourth Ave., New York City........1913
Edgar J. Buttenheim, President, 443 Fourth Ave., New York City.
Theodore R. Kendall, Editor, 443 Fourth Ave., New York City.
AMERICAN CONCRETE PIPE ASSOCIATION, 111 W. Washington St., Chicago, Ill...1923
M. W. Loving, Secretary, 111 W. Washington St., Chicago, Ill.
AMERICAN TAR PRODUCTS COMPANY, 208 S. La Salle St., Chicago, Ill...1921
P. L. Griffiths, Manager Tar-Mac Dept., 208 S. La Salle St., Chicago, Ill.
E. O. Rhodes, Director of Chemistry, 208 S. La Salle St., Chicago, Ill.

Anderson, A. M., Secretary-Treasurer, Rep. Elgin Sales Corp., Chicago, Ill.
ASPHALT ASSOCIATION, THE, 25 W. 43d St., New York City....1919
J. E. Pennybacker, Secretary, 25 W. 43d. St., New York City.
ASPHALT SALES CORPORATION, 128 N. Wells St., Chicago, Ill....1921
Fred C. Campbell, 128 N. Wells St., Chicago, Ill.
H J Gillum, President, 128 N. Wells St., Chicago, Ill.
ATLANTIC BITULITHIC COMPANY, 643–6 Munsey Bldg., Washington, D. C..1913
George O. Tenney, President, 643–6 Munsey Bldg., Washington, D. C.

Baker, H. B., Rep. Holt Manufacturing Co., Peoria, Ill.
Baker, W. D., Rep. Warner-Quinlan Asphalt Co., 79 Wall St., New York City.
BARBER ASPHALT COMPANY, THE, Land Title Bldg., Philadelphia, Pa..1913
C. N. Forrest, Manager Technical Dept., Maurer, N. J.
J. Strother Miller, Jr., Chief Chemist Technical Dept., Maurer, N. J.
J. E. Morris, Manager Street and Road Dept., Land Title Building, Philadelphia, Pa.
Barbour, J. G., Secretary, Rep. Metropolitan Paving Brick Co., Canton, Ohio
Barrett, R. R., Assistant Superintendent of Eastern Div., Rep. The Texas Co., Asphalt Sales Dept., 17 Battery Place, New York City.
BARRETT COMPANY, THE, 40 Rector St., New York City........1906
Walter Buehler, Engineer for Paving and Wood Preservation, 40 Rector St., New York City.
C. L. Campbell, 705 La Clede Gas Bldg., St. Louis, Mo.
W. H. Caruthers, Manager Paving Dept., Fairfield, Ala.
Geo. E. Martin, Highway Engineer, 10 S. La Salle St., Chicago, Ill.
Philip P. Sharples, Manager Tarvia Dept., 40 Rector St., New York City.
Benedict, E. L., Vice-President and Manager of Sales, Rep. National Steel Fabric Co., First National Bank Bldg., Pittsburg, Pa.
BARTH ENGINEERING AND SANITATION COMPANY, 11 E. 47th St., New York City.......................................1922
BIRMINGHAM SLAG COMPANY, 1607 Jefferson County Bank Bldg., Birmingham, Ala.......................................1920
C. E. Ireland, Sales Manager, 1607 Jefferson County Bank Bldg., Birmingham, Ala.
J. A. Glozier, Atlanta Branch Manager, 212 Walton Bldg., Atlanta, Ga.
BITOSLAG PAVING COMPANY, 90 West St., New York City.....1922
W. G. Coats, 90 West St., New York City.
Blackmer, A. E., Second Vice-President and Sales Manager, Rep. Blackmer and Post Pipe Co., Boatmen's Bank Bldg., St. Louis, Mo.
BLACKMER AND POST PIPE COMPANY, 1206 Boatmen's Bank Bldg., St. Louis, Mo..1912
A. E. Blackmer, Second Vice-Pres. and Sales Manager, Boatmen's Bank Bldg., St. Louis, Mo.
Blair, Will P., Vice President, Rep. National Paving Brick Manufacturers Association, 828–34 B. L. E. Bldg., Cleveland, Ohio.
BOOTH BROTHERS AND HURRICANE ISLE GRANITE COMPANY, 208 Broadway, New York City...................1917
Charles Mitchell, Treasurer, 208 Broadway, New York City.
Bramley, M. F., President, Rep. Cleveland Trinidad Paving Co., 886 The Arcade, Cleveland, Ohio

Buehler, Walter, Engineer of Paving and Wood Preservation, Rep. The Barrett Co., 40 Rector St., New York City.
Burns, Howard E., Rep. Superior Garbage Incinerator Co. of Tex., Praetorian Bldg., Dallas, Tex.
Burrows, Horace E., President, Rep. The Modern City Publishing Co., Ten Hills, Md.
Buttenheim, Edgar J., President, Rep. The American City, 443 Fourth Ave., New York City.

Campbell, C. L., District Manager Tarvia Dept., Rep. The Barrett Co. 705 La Clede Gas Bldg., St. Louis, Mo.
Campbell, Fred C., Rep. Asphalt Sales Corp., 128 N. Wells St., Chicago, Ill.
CANADA CRUSHED STONE CORPORATION, LTD., Dundas, Ont., Can..........1919
C. M. Doolittle, President, Dundas, Ont., Can.
CAREY COMPANY, PHILIP, Cincinnati, O..........1923
O. R. Fullenwider, Cincinnati, O.
Caruthers, W. H., Manager Paving Dept., The Barrett Co., Fairfield, Ala.
CENTRAL CLAY PRODUCTS COMPANY, 101 Scott St., Wilkes-Barre, Pa..........1922
Claude S. King, 101 Scott St., Wilkes-Barre, Pa.
CINCINNATI QUARRIES COMPANY, 108 Bell Block, Cincinnati, Ohio..........1921
Geo. W. Doran, Pres., 108 Bell Block, Cincinnati, Ohio.
CLAY PRODUCTS ASSOCIATION, 913 Chamber of Commerce, Chicago, Ill..........1918
George C. D. Lenth, Secretary and Consulting Engineer, 913 Chamber of Commerce, Chicago, Ill.
CLEVELAND TRINIDAD PAVING COMPANY, 886 The Arcade, Cleveland, Ohio..........1915
M. F. Bramley, President, 886 The Arcade, Cleveland, Ohio.
Clews, Harry T., Secretary, Rep. The Tomkins Cove Stone Co., 30 Church St., New York City.
Coats, W. G., Rep. Bitoslag Paving Co., 90 West St., New York City.
Covert, C. C., Rep. W. & L. E. Gurley Co., Troy, N. Y.
Craven, Jr., William D., Engineer Asphalt Paving and Road Construction, Rep. Standard Oil Co., (N. Y.) Room 1306, 26 Broadway, New York City.
CRESSY ROAD SPRAYER MANUFACTURING COMPANY, 462 Second St., Everett, Mass..........1920
Richard R. Pebworth, President, 462 Second St., Everett, Mass.
Cutter, Frank G., Assistant to President, Rep. Warren Brothers Company, 848 Otis Bldg., Chicago, Ill.

DeBerard, W. W., Western Editor, Rep. Engineering News-Record, 1570 Old Colony Bldg., Chicago, Ill.
Dickey, W. S., President, Rep. W. S. Dickey Clay Manufacturing Co., 200 New York Life Bldg., Kansas City, Mo.
DICKEY CLAY MANUFACTURING COMPANY, THE W. S., 200 New York Life Bldg., Kansas City, Mo..........1921
W. S. Dickey, President, 200 New York Life Bldg., Kansas City, Mo.
D'Olier, William L., Chief Engineer, Rep. The Sanitation Corp., 1533 Girard Ave., Philadelphia, Pa.
Doolittle, C. M., Rep. Canada Crushed Stone Corp., Dundas, Ont., Can.
Doran, George W., President, Rep. The Cincinnati Quarries Co., 108 Bell Blk., Cincinnati, O.

DORR COMPANY, THE, 101 Park Ave., New York City............1920
J. S. Sherman, Chief Municipal Sewage Section, 101 Park Ave., New York City.
Doyle, W. J., Rep. Uvalde Rock Asphalt Co., San Antonio, Tex.
Draney, J. R., General Sales Manager, Rep. The U. S. Asphalt Refining Co., 90 West St., New York City.
Duff, Jr., E. E., Secretary, Rep. National Paving Brick Manufacturers' Association, 830 B. L. E. Bldg., Cleveland. O.
Dunn, Frank B., President, Rep. Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio.
DUNN WIRE CUT-LUG BRICK COMPANY, Conneaut, Ohio 1911
F. B. Dunn, President, Conneaut, Ohio.
J. C. Travilla, Consulting Engineer, Room 1018, 211 N. 7th St., St. Louis, Mo.
DUSTOLINE FOR ROADS COMPANY, Summit, N. J..............1917
Edwin R. Lamson, President, Summit, N. J.
Duty, Spencer M., President, Rep. Medal Paving Brick Co., 4900 Euclid Ave., Cleveland, Ohio.

EASTERN CLAY PRODUCTS ASSOCIATION, 906 Colonial Trust Bldg., Philadelphia, Pa..1920
H. T. Shelley, Secretary, 906 Colonial Trust Bldg., Philadelphia, Pa.
EASTERN PAVING BRICK MANUFACTURERS' ASSOCIATION, Lincoln Bldg., Philadelphia, Pa...............................1920
W. C. Perkins, Secretary, 1016 Lincoln Bldg., Philadelphia, Pa.
Ege, C. R., Engineer Road Bureau, Rep. Portland Cement Association, 111 W. Washington St., Chicago, Ill.
ELGIN SALES CORPORATION, 10 S. La Salle St., Chicago, Ill.....1920
A. M. Anderson, Secretary-Treasurer, 10 S. La Salle St., Chicago, Ill.
Ellis, A. R., Rep. Pittsburg Testing Laboratory, 7th and Bedford Aves., Pittsburg, Pa.
ENGINEERING NEWS RECORD, 10th Ave., and 36th St., New York City...1920
R. K. Tomlin, Associate Editor, 10th Ave. and 36th St., New York City.
W. W. DeBerard, Western Editor, 1570 Old Colony Bldg., Chicago, Ill.
ESSCO MANUFACTURING COMPANY, Peoria, Ill................1923
L. W. McOmber, Peoria, Ill.

Ferguson, W. C., Rep. Ferguson Segment Block Co., 1802 Arcade Bldg., St. Louis, Mo.
FERGUSON SEGMENT BLOCK COMPANY, 1802 Arcade Bldg., St. Louis, Mo...1919
W. C. Ferguson, President, 1802 Arcade Bldg., St. Louis, Mo.
Fisher, Henry, Manager Road Oil Dept., Rep. Standard Oil Co., (N. Y.), Room 600, 26 Broadway, New York City.
Forrest, C. N., Manager Technical Dept., Rep. Barber Asphalt Co., Maurer, N. J.
FRANCO-AMERICAN WOOD TRANSFORMATION CORPORATION, 131 Church St., Wallingford, Conn................1921
Arthur C. Smith, Chief Engineer, 112 S. Whittlesey Ave., Wallingford, Conn.
FRANKLIN CONTRACTING COMPANY, 20 Washington Place, Newark, N. J...1921
John L. Hill, Engineer, 20 Washington Place, Newark, N. J.
Alex Reed, 20 Washington Place, Newark, N. J.

Fullenwider, O. R., Rep. Philip Carey Co., Cincinnati, O.
Fulweiler, W. H., Chemist, Rep. The United States Gas Improvement Co., 1706 N. Broad St., Philadelphia, Pa.

Gartland, John J., Jr., Superintendent Eastern Div., Rep. The Texas Co., Asphalt Sales Dept., Whitehall Bldg., 17 Battery Place, New York City.
Gillum, H. J., Pres. Rep. Asphalt Sales Corp., 128 N. Wells St., Chicago, Ill.
Glozier, J. A., Atlanta Branch Manager, Rep. Brimingham Slag Co., 212 Walton Bldg., Atlanta, Ga.
GRANITE PAVING BLOCK MANUFACTURERS' ASSOCIATION OF THE UNITED STATES, 31 State St., Boston, Mass.........1915
J. J. Tobin, Secretary, 31 State St., Boston, Mass.
F. T. Mason, 1229 Atlanta Trust Bldg., Atlanta, Ga.
GREENOUGH, MAURICE B., Vice President Southern Clay Manufacturing Co., 801 Volunteer Bldg., Chattanooga, Tenn..........1915
Griffiths, P. L., Manager Tar-Mac Dept., Rep. American Tar Products Co., 208 S. La Salle St., Chicago, Ill.
GURLEY COMPANY, W. AND L. E., Troy, N. Y..................1923
C. C. Covert, Troy, N. Y.

Haff, Robert W., President, Rep. Inland Engineering Corp., 15 William St., New York City.
Hall, John W., Rep. Westport Paving Brick Co., Westport, Baltimore, Md.
HARRIS GRANITE QUARRIES COMPANY, Salisbury, N. C.......1915
R. G. Hunt, Drawer 267, Salisbury, N. C.
HASTINGS PAVEMENT COMPANY, 25 Broad St., New York City...1920
T. J. McNally, 25 Broad St., New York City.
P. L. Thompson, Sales Manager, 25 Broad St., New York City.
Helm, J. S., Rep. Standard Oil Co., (La.), 9th Floor, United Fruit Bldg., New Orleans, La.
Hempelmann, W. L., Engineer of Middle West Div., Rep. The Texas Co., Asphalt Sales Dept., 540 Otis Bldg., 10 S. La Salle St., Chicago, Ill.
Hildreth, H. V., General Manager, Rep. Hildreth Granite Co., 31 State St., Boston, Mass.
HILDRETH GRANITE COMPANY, 31 State St., Boston, Mass. ...1914
H. V. Hildreth, General Manager, 31 State St., Boston, Mass.
Hill, John L., Engineer, Rep. Franklin Contracting Co., 20 Washington Place, Newark, N. J.
Hirsch, Allen M., President, Rep. Lock Joint Pipe Co., P.O. Box 21, Ampere, N. J.
Hogan, F. A., Asphalt and Road Oil Dept., Rep. Imperial Oil Co., Ltd., 56 Church St., Toronto, Ont., Can.
HOLOPHANE GLASS COMPANY, INC., 342 Madison Ave., New York City..1922
T. W. Rolph, Newark, Ohio.
HOLT MANUFACTURING COMPANY, THE, Peoria, Ill..........1920
H. B. Baker, Peoria, Ill.
Hunt, R. G., Rep. Harris Granite Quarries Co., Drawer 267, Salisbury, N. C.
Hvass, Charles T., President, Rep. Charles T. Hvass & Co., New York City.
HVASS AND COMPANY, CHARLES T., New York City..........1922
Charles T. Hvass, President, New York City.

IDEAL POWER LAWN MOWER COMPANY, Lansing, Mich. 1920
E. H. Peters, Manager Chicago Branch, 533 S. Dearborn St., Chicago, Ill.
IMPERIAL OIL COMPANY, LTD., 56 Church St., Toronto, Ont., Can.....1917
F. A. Hogan, Asphalt and Road Oil Dept., 56 Church St., Toronto, Ont., Can.
INLAND ENGINEERING CORPORATION, 15 William St., New York City.....1921
Robert W. Haff, President, 15 William St., New York City.
Ireland, C. E., Sales Manager, Rep. Birmingham Slag Co., 1607 Jefferson County Bank Bldg., Birmingham, Ala.

Johnson, Alfred H., President, Rep. Texas Bitulithic Co., Praetorian Bldg., Dallas, Tex.

Kaull, Pardon S., Vice-President, Rep. Warren Brothers Co., Railway Exchange Bldg., St. Louis, Mo.
Kelly, J. M., Secretary, Rep. The Sanitation Corp., 165 Broadway, New York City.
Kemp, Louis W., Superintendent Southwestern Div., Rep. The Texas Co., Asphalt Sales Dept., Houston, Tex.
Kendall, Theodore Reed, Editor, Rep. The American City, 443 Fourth Ave., New York City.
Kennedy, Dennis A., Superintendent of New England Div., Rep. The Texas Co., Asphalt Sales Dept., 714 Tremont Bldg., 73 Tremont St., Boston, Mass.
Kershaw, W. H., Manager, Rep. The Texas Company, Asphalt Sales Dept., 1904 Whitehall Bldg., 17 Battery Place, New York City.
King, Claude Sadler, Rep. Central Clay Products Co., 101 Scott St., Wilkes-Barre, Pa.

Lamson, Edwin R., President, Rep. Dustoline for Roads Co., Summit, N. J.
Lamson, Geo. W., Rep. Standard Oil Co., (N. Y.,) Asphalt Div., 811 Railway Exchange Bldg., Chicago, Ill.
Law, Leroy M., Chief Chemist, Rep. New Orleans Refining Co., 309 Maison Blanche Annex, New Orleans, La.
Lenth, George, C. D., Secretary and Consulting Engineer, Rep. Clay Products Association, 913 Chamber of Commerce Bldg., Chicago, Ill.
Leopold, J. L., Rep. J. L. Leopold and Co., 233 Broadway, New York City.
LEOPOLD AND COMPANY, J. L., 233 Broadway, New York City...1915
J. L. Leopold, 233 Broadway, New York City
Lewis, W. H., President, Rep. F. J. Lewis Mfg. Co., 2500 S. Robey St., Chicago, Ill.
LEWIS MANUFACTURING COMPANY, F. J., 2500 S. Robey St., Chicago, Ill.....1920
W. H. Lewis, President, 2500 S. Robey St., Chicago, Ill.
LINK BELT COMPANY, Nicetown, Philadelphia, Pa.....1923
M. B. Tark, Nicetown, Pa.
Lippincott, J. H., District Manager, Rep. Warren Brothers Co., 50 Church St., New York City.
LOCK JOINT PIPE COMPANY, East Orange, N. J.....1908
Allen M. Hirsh, President, Box 21, Ampere, N. J.
H. F. Ahrens, Jr., Treasurer, Leonia, N. J.
Loving, M. W., Secretary, Rep. American Concrete Pipe Asso., 111 W. Washington St., Chicago, Ill.

Lucktenberg, Wm. H., Rep. National Paving Brick Manufacturers' Asso., The Burton-Townsend Co., Zanesville, Ohio.

Mackendrick, W. G., President, Rep. Warren Bituminous Paving Co., Toronto, Ont., Can.
Mandigo, Clark R., Engineer, Rep. Western Paving Brick Manufacturers' Asso., 317 Dwight Bldg., Kansas City, Mo.
Marker, J. R., Secretary, Rep. Ohio Paving Brick Manufacturers' Asso., 510 Hartman Bldg., Columbus, Ohio.
Martin, George E., Consulting Engineer, Rep. The Barrett Co., 10 S. La Salle St., Chicago, Ill.
Mason, Frank T., Rep. Granite Paving Block Manufacturers' Asso., 1220 Atlanta Trust Bldg., Atlanta, Ga.
Mason, Jr., L. R., Rep. Southern Willite Paving Co., 815 E. Franklin St., Richmond, Va.
McCandless, Wm. W., Rep. The Sanitation Corp., 165 Broadway, New York City.
McCormick, Porter S., Rep., Standard Oil Co., (N. J.) Asphalt Div., Baltimore, Md.
McNally, T. J., Rep. The Hastings Pavement Co., 25 Broad St., New York City.
McOmber, L. W., Rep. Essco Manufacturing Co., Peoria, Ill.
MEDAL PAVING BRICK COMPANY, THE, 4900 Euclid Ave., Cleveland, Ohio....................1911
  Spencer M. Duty, President, 4900 Euclid Ave., Cleveland, Ohio.
METROPOLITAN PAVING BRICK COMPANY THE, Canton, Ohio....................1911
  J. G. Barbour, Secretary, Canton, Ohio.
Miller, Jr., J. Strother, Chief Chemist Technical Dept., Rep. The Barber Asphalt Co., Maurer, N. J.
Miller, S. Fisher, President, Rep. Pacific Flush Tank Co., 149 Broadway, New York City.
Mitchell, Charles, President, Rep. Booth Brothers and Hurricane Isle Granite Co., 208 Broadway, New York City.
Modern City Publishing Company, 43 Franklin Building, Baltimore, Md....................1921
  Horace E. Burrows, President, Ten Hills, Md.
Morris, J. E., Manager Street and Road Dept., Rep. The Barber Asphalt Co., Land Title Bldg., Philadelphia, Pa.
Murphy, Charles E., Rep. The Texas Co., Asphalt Sales Dept., 17 Battery Place, New York City.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION, 828–34 Brotherhood of Locomotive Engineers' Bldg., Cleveland, Ohio....................1907
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  E. E. Duff, Jr., Secretary, 803 B. L. E. Bldg., Cleveland, Ohio.
  O. W. Renkert, President, Renkert Bldg., Canton, Ohio.
  W. H. Lucktenberg, The Burton-Townsend Co., Zanesville, Ohio.
NATIONAL STEEL FABRIC COMPANY, First National Bank Bank Bldg., Pittsburg, Pa....................1920
  E. L. Benedict, Vice-President and Manager Sales, First National Bank Bldg., Pittsburg, Pa.
Newbold, C. L., Rep. Warren Brothers Co., 1859 Railway Exchange Bldg., St. Louis, Mo.
NEW ORLEANS REFINING COMPANY, INC. 309 Maison Blanche Annex, New Orleans, La....................1920
  Leroy M. Law, Chief Chemist, 309 Maison Blanche Annex, New Orleans, La.

OHIO PAVING BRICK MANUFACTURERS' ASSOCIATION, 510 Hartman Bldg., Columbus, Ohio..........................1919
J. R. Marker, Secretary, 510 Hartman Bldg., Columbus, Ohio.

PACIFIC FLUSH TANK COMPANY, 4241 E. Ravenswood Ave., Chicago, Ill. and Singer Bldg., New York City..................1915
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E. L. Walcott, 4241 Ravenswood Ave., Chicago, Ill.
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Peters, E. H., Manager Chicago Branch, Rep. Ideal Power Lawn Mower Co., 533 S. Dearborn St., Chicago, Ill.
PITTSBURG TESTING LABORATORY, 7th and Bedford Aves., Pittsburg, Pa..1919
A. R. Ellis, 7th and Bedford Aves., Pittsburg, Pa.
PORTLAND CEMENT ASSOCIATION, 111 W. Washington St., Chicago, Ill...1919
C. R. Ege, Manager Highways Bureau, 111 W. Washington St., Chicago, Ill.

Read, Frank C., Head Chemist, Rep. Standard Oil Co. (La.), Box 249, Baton Rouge, La.
Reed, Alex., Rep. Franklin Contracting Co., 20 Washington Place, Newark, N. J.
Reed, T. H., Superintendent of Southern Div., Rep. The Texas Co., Asphalt Sales Dept., Jacksonville, Fla.
Reilly, P. C., President, Rep. Republic Creosoting Co., Merchants Bank Bldg., Indianapolis, Ind.
Renkert, O. W., President, Rep. National Paving Brick Manufacturers' Asso., Renkert Bldg., Canton, Ohio.
REPUBLIC CREOSOTING COMPANY, Merchants Bank Bldg., Indianapolis, Ind...1907
P. C. Reilly, President, Merchants Bank Bldg., Indianapolis, Ind.
Rhodes, E. O., Director of Chemistry, Rep. American Tar Products Co., 208 S. La Salle St., Chicago, Ill.
Rightor, Fred E., President and Treasurer, Rep. Southwest Bitulithic Co., 704 Gunter Bldg., San Antonio, Tex.
Robinson, E. M., District Manager, Rep. Warren Brothers Co., 1414 Bank of Commerce Bldg., Memphis, Tenn.
ROCKPORT GRANITE COMPANY, Rockport, Mass...............1915
C. Harry Rogers, Rockport, Mass.
Rogers, C. Harry, Rep. Rockport Granite Co., Rockport, Mass.
Rolph, T. W., Rep. Holophane Glass Co., Newark, Ohio.

SAINT MARYS SEWER PIPE COMPANY, St. Marys, Pa..........1910
SANITATION CORPORATION, THE, 165 Broadway, New York City...1914
Wm. L. D'Olier, Chief Engineer, 1533 Girard Ave., Philadelphia, Pa.
J. M. Kelly, Secretary, 165 Broadway, New York City.
Wm. W. McCandless, 165 Broadway, New York City.

Schutte, August E., Consulting Chemist, Rep. Warren Brothers Co., 9 Cambridge St., Boston, Mass.

Sharples, Philip P., Technical Adviser, Rep. The Barrett Co., 40 Rector St., New York City.

Shelley, H. T., Secretary, Rep. Eastern Clay Products Asso., 906 Colonial Trust Bldg., Philadelphia, Pa.

Sherman, J. S., Chief Municipal Sewage Sec., Rep. The Dorr Co., Sanitary Engineering Dept., 101 Park Ave., New York City.

Smith, Arthur C., Chief Engineer, Rep. Franco-American Wood Transformation Corp., 112 Whittlesey Ave., Wallingford, Conn.

SOUTHERN WILLITE PAVING COMPANY, 815 Franklin St., Richmond, Va...1921

L. R. Mason, Jr., Richmond, Va.

SOUTHWEST BITULITHIC COMPANY, 704 Gunter Bldg., San Antonio, Tex...1922

Fred E. Rightor, President and Treasurer, 704 Gunter Bldg., San Antonio, Tex.

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STANDARD OIL COMPANY (LA.), 9th Floor, United Fruit Bldg., New Orleans, La...1915

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Wm. D. Craven, Jr., Engineer Asphalt Pavement and Road Contion, Room 1306, 26 Broadway, New York City.

Henry Fisher, Manager Road Oil Dept., Room 600, 26 Broadway, New York City.

Stewart, S. W., President, Rep. Ambursen Construction Co., 186 Fifth Ave., New York City.

Stivers, A. D., Engineer of Southwestern Div., Rep. The Texas Co., 1011 Southwestern Life Bldg., Dallas, Texas.

SUPERIOR GARBAGE INCINERATOR COMPANY OF TEXAS, Praetorian Bldg., Dallas, Tex...1919

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TEXAS BITULITHIC COMPANY, Praetorian Bldg., Dallas, Texas...1908

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TEXAS COMPANY, THE, Asphalt Sales Dept., 17 Battery Place, New York City...1911

R. R. Barrett, Assistant Superintendent of Eastern Div., 17 Battery Place, New York City.

John J. Gartland, Jr., Superintendent Eastern Div., Whitehall Bldg., New York City.

W. L. Hempelmann, Engineer of Middle West Div., 540 Otis Bldg., 10 S. La Salle St., Chicago, Ill.

Louis W. Kemp, Superintendent Southwestern Div., Houston, Tex.

Dennis A. Kennedy, Superintendent of New England Div., 714 Tremont Bldg., 73 Tremont St., Boston, Mass.
W. H. Kershaw, General Manager, 1904 Whitehall Bldg., 17 Battery Place, New York City.
C. E. Murphy, 17 Battery Place, New York City.
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Thompson, Philip L., Sales Manager, Rep. Hastings Pavement Co., 25 Broad St., New York City.
Thurston, George W., Secretary, Rep. Western Paving Brick Manufacturers' Asso., 317 Dwight Bldg., Kansas City, Mo.
Tobin, J. J., Rep. Granite Paving Block Manufacturers' Asso., 31 State St., Boston, Mass.
TOMKINS COVE STONE COMPANY, 30 Church St., New York City....1921
Harry T. Clews, Secretary, 30 Church St., New York City.
Tomlin, R. K., Associate Editor, Rep. Engineering News-Record, 10th Ave. and 36th St., New York City.
Travilla, J. C., Consulting Engineer, Rep. Dunn Wire-Cut Lug Brick Co., Room 1018, 211 N. 7th St., St. Louis, Mo.

UNITED GAS IMPROVEMENT COMPANY, THE, 1706 N. Broad St., Philadelphia, Pa....1913
W. H. Fulweiler, Chemist, 1706 N. Broad St., Philadelphia, Pa.
UNITED STATES ASPHALT REFINING COMPANY, THE, 90 West St., New York City....1913
J. R. Draney, General Sales Manager, 90 West St., New York City.
UVALDE ROCKASPHALT COMPANY, San Antonio, Tex....1923
W. J. Doyle, San Antonio, Tex.

Walcott, E. L., Rep. Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.
WARNER-QUINLAN ASPHALT COMPANY, 79 Wall St., New York City....1913
W. D. Baker, 79 Wall St., New York City.
WARREN BITUMINOUS PAVING COMPANY, Toronto, Ont., Can....1919
W. G. Mackendrick, President, Toronto, Ont., Can.
Warren, George C., Chairman of Executive Committee, Rep. Warren Brothers Co., 9 Cambridge St., Boston, Mass.
Warren, Ralph L., Vice-President and General Manager, Rep. Warren Brothers Co., 9 Cambridge St., Boston, Mass.
WARREN BROTHERS COMPANY, Parkman Bldg., 9 Cambridge St., Bowdoin Square, Boston, Mass....1905
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WEST CONSTRUCTION COMPANY, Kinston, N. C. 1921
L. B. West, President, Kinston, N. C.
WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION, 317 Dwight Bldg., Kansas City, Mo. 1912
George W. Thurston, Secretary, 317 Dwight Bldg., Kansas City, Mo.
Clark R. Mandigo, Engineer, 317 Dwight Bldg., Kansas City, Mo.
WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, South Bend, Ind. 1921
L. A. S. Wood, South Bend, Ind.
WESTPORT PAVING BRICK COMPANY, Westport, Baltimore, Md. 1921
John W. Hall, Westport, Baltimore, Md.
Widger, F. V., Superintendent of Middle West Div., Rep. The Texas Co., Asphalt Sales Dept., 540 Otis Bldg., 10 S. La Salle St., Chicago, Ill.
Wood, L. A. S., Rep. Westinghouse Electric and Manufacturing Co., South Bend, Ind.
Young, A. R., Chief Engineer, Rep. The Texas Co., Asphalt Sales Department, 212 Dwight Bldg., Tenth and Baltimore Ave., Kansas City, Mo.

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(From *The Automobilist*, September, 1922)

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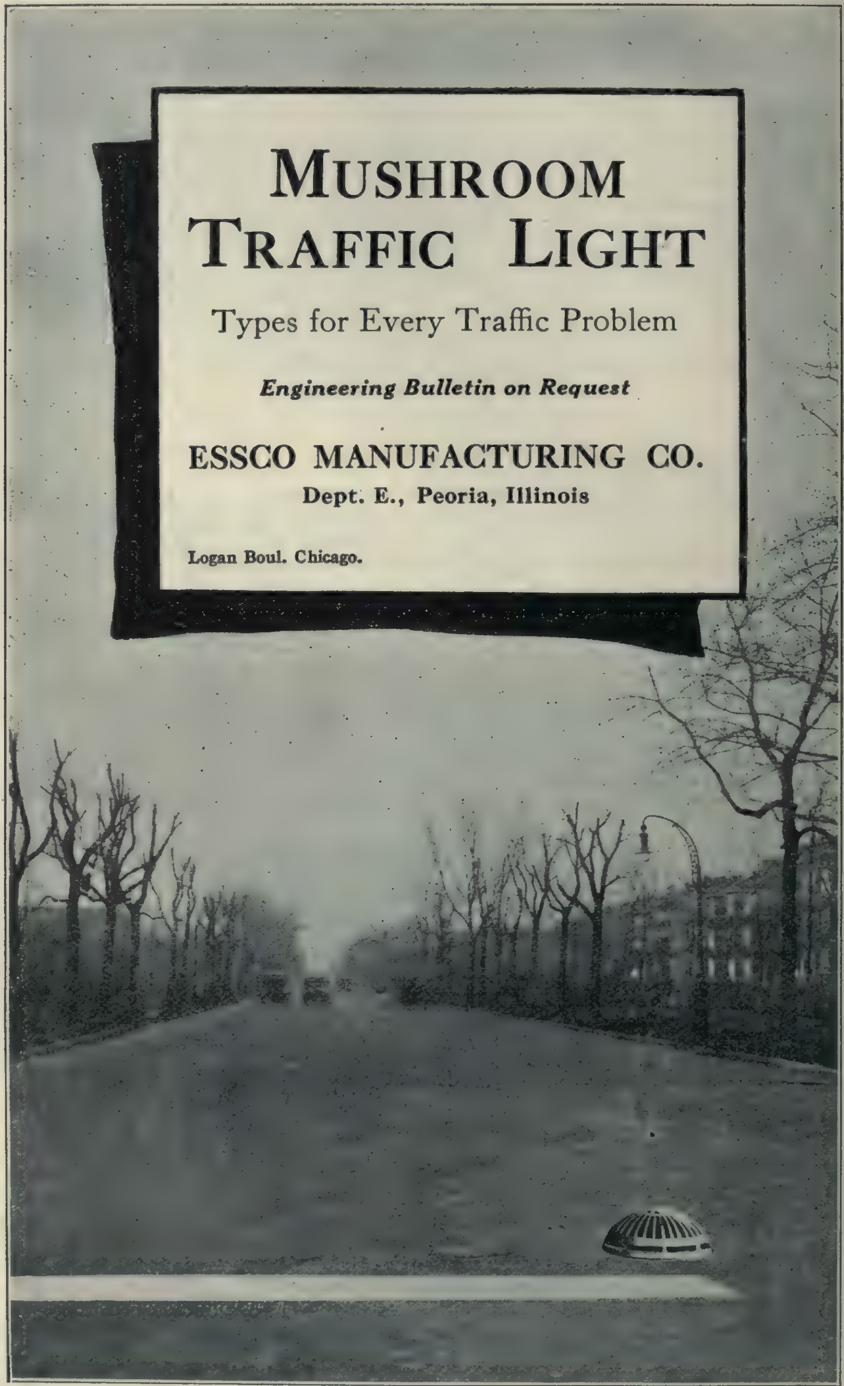

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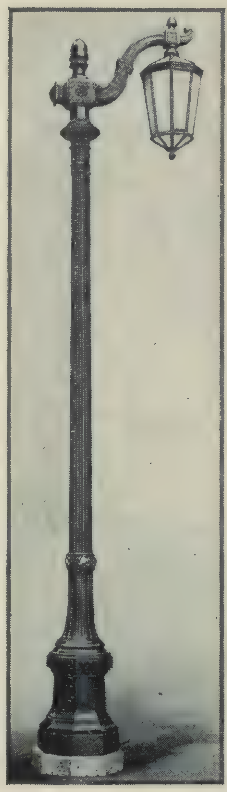

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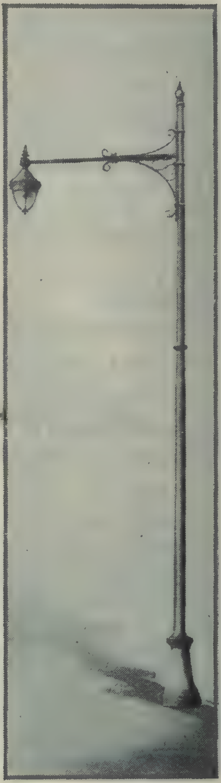

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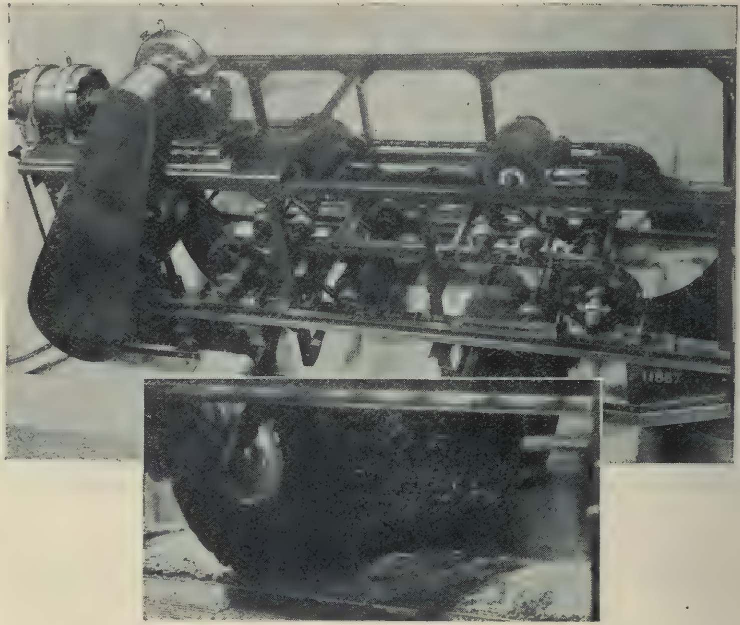

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